



# WPI



## Transit in the Capital of Enchantment: Improving Rider Information and Services

An Interactive Qualifying Project Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

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Santa Fe Public Transit System – Rebecca Renner, Elizabeth Miloscia, Giovanni Di Cristina

Challenges Faced By Santa Fe Trails – Giovanni Di Cristina, Kshitij Thapa

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# Abstract

The main goal of this project was to increase utilization of the Santa Fe Trails public transportation system. The goal was achieved by focusing on improving service and quality of information, as well as by proposing additional services to better utilize existing resources. To improve quality of information we conducted surveys and person-to-person interactions to assess the quality of bus information available to riders. To quantify the current level of utilization, we analyzed surveys given to bus riders. We used the data to see when riders are utilizing the system, how long they are traveling to and from stops to measure how accessible the system is, and why riders are utilizing the system. To investigate ways to redistribute resources and create new services, an express bus was piloted for the busiest line and the feasibility of a shuttle that runs between all the colleges and other popular places for students was determined. Finally, preliminary research was conducted to assist the Santa Fe Trails in piloting a feeder system in the future. These proposals could greatly benefit Santa Fe Trails by providing services that target rider demands if they were to be implemented.

# Executive Summary

The Santa Fe Trails (SFT) bus system is the primary form of public transportation in the city, with 10 routes that include 470 stops. Despite its extensive coverage and long operating hours, the SFT bus system has fairly low ridership, compared to similar western cities<sup>1</sup>. Several changes and improvements to improve ridership have been initiated by the SFT, including the development of a prototype mobile web app, and the deployment of newly designed bus signs and shelters. Although these changes will certainly improve the system, there are other possible ways to further increase ridership<sup>2</sup>.

The goal of our project was to assist the Santa Fe Trails' efforts to increase utilization by improving service and quality of information. We accomplished this goal by measuring ways to improve the quality of information available to riders, determining the current level of utilization, and proposing new services by redistributing resources.

Over the past year, Santa Fe Trails worked on making new bus stop signs and shelters that include more information for riders. In order to gain feedback on these new



signs, as well as other rider information we conducted a survey that was distributed on all the bus routes for three days. We also talked one-on-one to riders at these new bus stops in order to gain more detailed responses. Based on our survey results, 71% of people find the new signs easy to read. By talking to riders one-on-one, we found that most people agreed a “you are here” sticker on bus stop signs would help make them easier to interpret, especially for tourists using the system for the first time. Furthermore, 33% of people access information from the Santa Fe Trails website on their smartphones and 62% of riders would be interested in a text messaging service to get current bus information. Based on our results, we recommend adding a “you are here” sticker to all

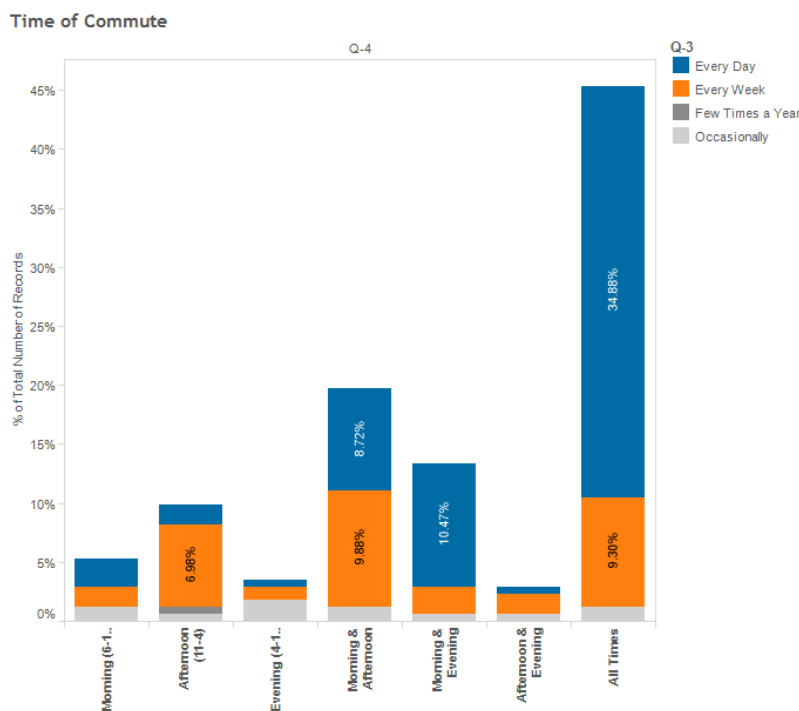
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<sup>1</sup> Brevig, 2013

<sup>2</sup> Idem

the new bus stop signs, and that the new app being planned includes a trip planner and alerts, so that smartphone users can access all their bus information in one place. Lastly, we asked riders if a text messaging service would be helpful for them. Texting a number that is specific to a particular bus stop would give riders current bus information as well as bus arrival times. Since not everyone in Santa Fe has a smartphone, a text messaging service improves the information available to non-smartphone users making it easier for riders to get on the bus, increasing ridership.

The distributed surveys also captured data on utilization. We wanted to learn when the buses are heavily utilized and how often riders use the system. We also investigated the

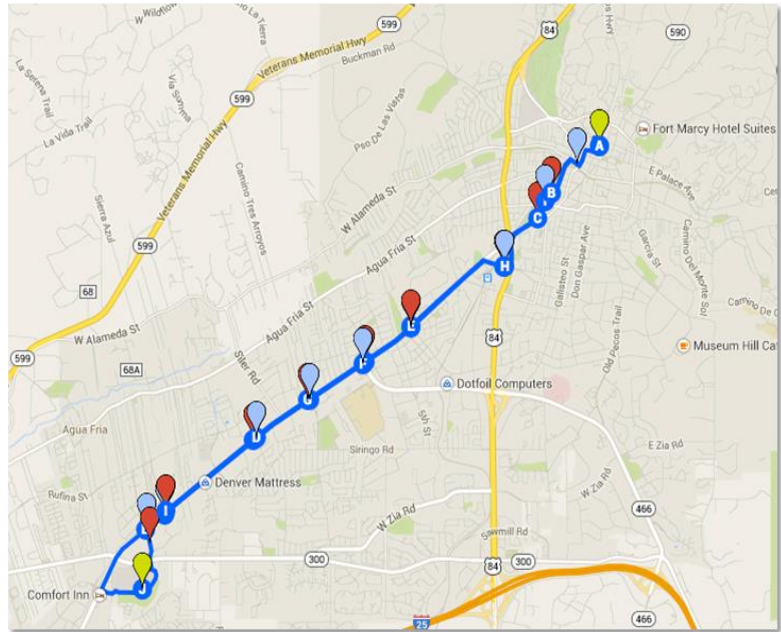


most common purposes of travel. Next, we gathered data on how long passengers spend traveling to their originating bus stop from their starting point and likewise from their destination stop to their final destination. Finally, we sought to learn how satisfied riders were with the system overall. From our surveys, about 45% of passengers reported riding the bus at all times of the day with the majority of those riders

riding every day. The prevailing reasons for using the bus were: school (42%), work (46%), and shopping (49%). A majority (46%) of respondents reported that they travel fewer than five minutes to their originating bus stop from their starting point, but many (30%) reported spending more than 15 minutes from their disembarking bus stop to their final destination. Finally, a majority of passengers (75%) rated the overall bus system “good” or better with only a small fraction 3% rating is as “bad”.

During our project, we explored three new services that we believe would be beneficial to Santa Fe Trails and its riders. The first is an express bus for Route 2. This route carries more than half of the yearly passengers and is often crowded. By conducting observations of where riders got on and off the bus we identified the 12 most commonly

used stops and then ran a pilot test of an express line that only stopped at these 12 places. The pilot test was run from 7-9am and 4:30-6:30pm for 3 days. These times were chosen to target those that use the bus to commute to work and back. The pilot test had 37 participants, 23 of whom filled out evaluation forms rating the service. 78% of people that filled out the form rated the service as “excellent”. The express bus reduced the end-to-end travel time by one-third, shaving 10 minutes from the scheduled 35 minutes that the normal bus would take. Based on the results we got from the pilot test, we recommended that Santa Fe Trails implement the Express Bus to Route 2 on all weekdays. We analyzed two different options that SFT could take when making the Express line. One involved adding an additional bus while the other looked at making an existing bus an Express bus during the outlined times. We discuss the advantages and disadvantages of both options, including monetary costs in our recommendations chapter.



The second proposed service is a shuttle running among the colleges in Santa Fe and a few popular destinations in the city. It was brought to our attention both through a suggestion from our liaison at Santa Fe Trails and our survey results, that college students in Santa Fe are looking for a way to get to/from colleges on nights and weekends when the normal bus service is not running. Both the Institute of American Indian Arts and the Santa Fe Community College have no weekend service from the fixed-route buses run by Santa Fe

Trails. In our surveys, 16 out of 181 respondents wrote that they would like service to the colleges that includes nights and weekends. To answer this demand, we designed a route that included all 4 colleges in Santa Fe as well as downtown, Santa Fe Place Mall, and Santa Fe Depot (the transportation hub that includes the Rail Runner train system). This route would take about an hour one way and from this information, we proposed a schedule. Our recommendation is to have the shuttle run on Friday nights and all day Saturday. However, because IAIA and SFCC are the only two schools not covered during the day, the shuttle could run on a shorter path from those two schools to the mall where anyone could pick up another bus. We took this proposed schedule and created a cost-benefit analysis showing different options for frequencies that this shuttle could run and how much each option would cost based on the number of buses that would be needed.

The last proposed service, a solution to the first and last mile problem (the difficulty in reaching a bus stop from your origin or destination and vice versa), is a feeder system. This service would take riders to and from bus stops. We did a preliminary study to assist Santa Fe Trails with piloting a feeder system. Using the Fort Marcy Hotel Shuttle, a free taxi like service provided for Fort Marcy residents that operates within a 3 mile radius, we collected data on the shuttle’s wait time, travel time, and usage. Along with this data, we

**Table 1: Stats on Wait Time for Fort Marcy Shuttle**

	All Wait Times	From FM	To FM
<b>Standard Deviation</b>	5.57	7.77	6.43
<b>Median</b>	8.00	3.00	7.50
<b>Average</b>	8.65	6.60	8.50

investigated the feeder system in Denver. Using both data sets, we recommend 1 van per 10,000 population for the pilot test in Santa Fe, with 1 extra van ready on stand-by

to be utilized during busy hours. Vans should operate during the same hours as the fixed bus routes. As for the stations for vans, we recommend placing them at a bus stop near the center of the coverage area. Figure 35 shows our two recommended areas of Santa Fe where a feeder system could be most utilized. Both areas have a population of 13,000 in accordance with the one van recommendation. It will be up to future studies to determine which of the two they would like to select for the pilot test.

These proposals could greatly benefit Santa Fe Trails by providing services that target rider demands if they were to be implemented.



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# 1. Introduction

Public transportation serves as the primary mode of travel for the majority of people in many countries. However, in the United States public transportation systems are poorly utilized. For example, Russia's public transportation system is highly utilized with 52% of people using it almost every day and only 1% of people never using it<sup>3</sup>. By contrast, in 2011, there were about 138 million people working in the United States, yet only 5% percent took public transportation to work, while 76.4% of those workers drove alone and 61% of people never used public transportation<sup>4</sup>. This could be due to the fact that population densities are lower in the United States than in denser countries like China and India, an inclination to drive cars due to cultural norms, higher average income, and subsidies associated with car usage<sup>5</sup>.

With its small population, New Mexico's population density is the 6<sup>th</sup> lowest in the US<sup>6</sup>. Unsurprisingly, its capital Santa Fe is one of the smallest state capitals in the US with a population size of just 82,000<sup>7</sup>. With its sparse settlements, travel destinations are located much further away in Santa Fe than in larger cities. Perhaps due to this distance, almost 83% of the regular commuters in Santa Fe take cars in contrast to only 1.4% who take public transportation<sup>8</sup>. This popularity of cars and private vehicles leads to underutilization of public transportation. But there are great examples to learn from as Santa Fe's neighboring city of Albuquerque has the 6th best bus coverage in the country<sup>9</sup>.

The Santa Fe Trails bus system is the primary form of public transportation in the city. It has 10 routes that include 470 bus stops. Although it has stops and routes that canvas a large part of the city, there is still very low ridership when compared to similarly sized cities like Waterloo IA, Sioux SD, and Rochester MN<sup>10</sup>. Several changes and improvements have been made to the system to raise ridership, including the evaluation of a potential mobile app, addition of a pick-up service in order increase service area and frequency, and a new design of bus stop signs for improved clarity. In 2011 there were

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<sup>3</sup> Benfield, 2009.

<sup>4</sup> Bureau of Transportation Statistics, 2011

<sup>5</sup> Buehler, 2013

<sup>6</sup> Bureau, 2010

<sup>7</sup> Santa Fe New Mexican, 2014

<sup>8</sup> Bureau, 2010

<sup>9</sup> Thompson, 2011

<sup>10</sup> Sioux Area Metro – Transit System Analysis, 2012

993,200 passengers as opposed to 880,300 in 2010<sup>11</sup> a rate of increase exceeding the population growth in the city. Though the number of people using the bus is growing, there are still things that can be done in order to improve utilization of the current system.

The increase in ridership over the past few years has created a need for Santa Fe Trails to focus on increasing accessibility for its customers. They have made several strides towards improving accessibility, as evidenced by a mobile app currently in development, improved signage, the addition of live bus locations on the web, and the design of a feeder service to facilitate better service. Through examples from other bus systems and exploring the current system, we will propose new changes that will increase bus ridership. First, there is a need for improved rider information. Next, the system needs to be assessed to determine its current level of utilization. Finally, new resources such as an express bus, college shuttle and feeder system will be explored for their feasibility. These additions will complement the recommendations by previous research groups as data on the effect of their changes will strengthen the argument towards a need for change.

The goal of our project is to assist the Santa Fe Trails' efforts to increase utilization by improving service and quality of information. In order to accomplish this, we assessed the quality of information available to riders through surveys and interactions. Tangible and digital information was analyzed in order to understand where improvements could be made. We also assessed the current level of utilization for the routes of the fixed route bus using previous years' ridership data as well as our own observations. Through these observations and feedback from riders we explored new resources such as a feeder system, an express bus and a college shuttle.

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<sup>11</sup> Apta, 2013

## 2. Background

Public transportation is a helpful resource used all over the world. The services and structures of transit systems depend on the area they cover. However, there are universal problems that all systems face and, likewise, solutions that many successful systems utilize.

In the following sections, we discuss transportation options in New Mexico; explore the public transit services available in Santa Fe, and the challenges faced by the Santa Fe Trails department as well as solutions other systems have implemented.

### 2.1 Population Trends & Transportation in New Mexico

The popularity of cars in the United States has steadily increased since the 1950's. While the American population has doubled, the purchase of cars has more than tripled<sup>12</sup>. Thus population growth is not the only reason for the increase in car purchases. Influenced by increased availability of cars and personal wealth, Americans are settling further from cities, resulting in increased commuting distances. This American lifestyle applies to New Mexico as well, where the number of cars has increased seven-fold since the 1950's. While the US population is concentrated along the east and west coasts, steady growth is seen in the southern states leaving many of the western states sparsely populated. Figure 1 shows the population density of various US counties.

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<sup>12</sup> City of Santa Fe, 2014



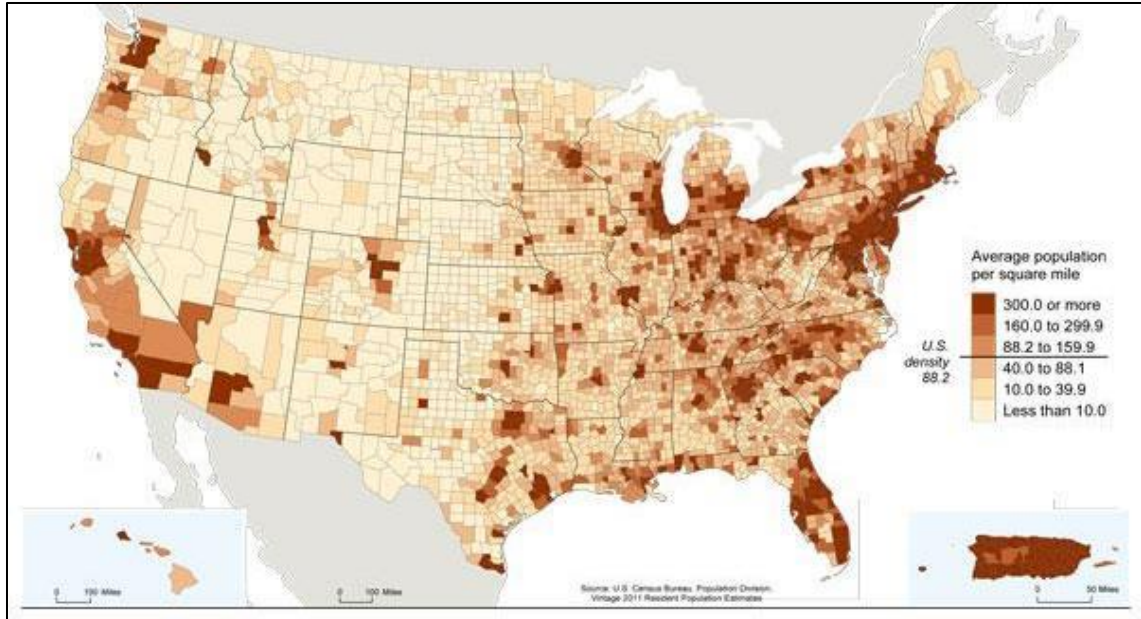


Figure 1: US Population Density 2011<sup>13</sup>

New Mexico, located west of Texas, has one of the lowest state populations, just over 2 million people, which is less than 1% of the total US population. Santa Fe, the capitol, has a population of 69,000 people with a sustaining a steady population growth for the past few years; 0.8% growth from 2011 to 2012<sup>14</sup>. However, in 2014 the population increased to 82,000 people as a result of annexation<sup>15</sup>. Santa Fe has a population density of 1,682 people per square mile.

### 2.1.1 Private Transportation in New Mexico

It's intuitive that residents in low population density areas have longer travel times and inversely, states with higher population density tend to have a shorter travel distance per vehicle. On average, New Mexico drivers have a longer travel distance per vehicle than the US, as shown in Figure 2. Measured as average amount of travel per vehicle based on annual vehicle miles traveled and state reported registered motor vehicle data, New Mexico ranked third in highest travel distances out of all US states in 2010.<sup>16</sup>

<sup>13</sup> U.S. Census Bureau, 2011

<sup>14</sup> City of Santa Fe, 2014

<sup>15</sup> Santa Fe New Mexican, 2014

<sup>16</sup> Office of Highway Policy Information, 2014

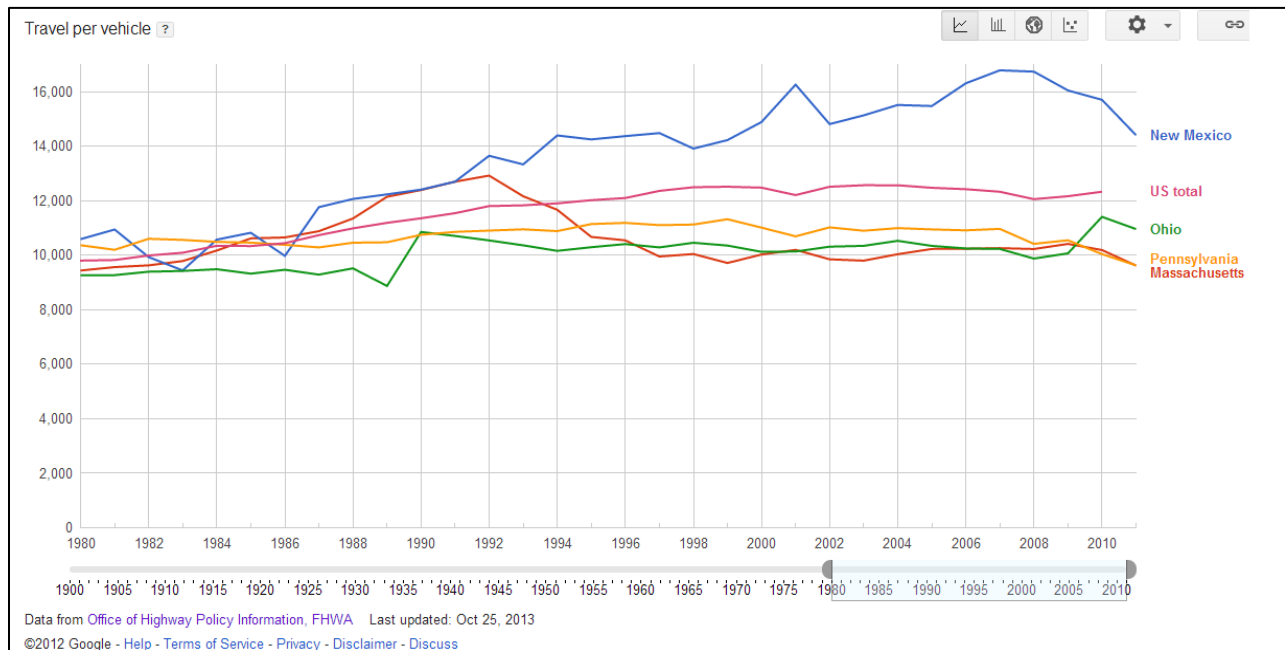


Figure 2: Travel per Vehicle: New Mexico vs. US Average<sup>17</sup>

With such large travel distances, the most convenient mode of transportation is a car. Relatively easy to acquire and operate, cars offer the most flexible transportation method and in 2010, New Mexico had about 0.85 vehicles per person.<sup>18</sup> However, car registration has decreased from 730,000 in 2000 to 700,000 in 2011. This fact, combined with a population increase of 28% in the same year, is a good indication that the growing population is moving away from the car culture. Popularity with cars is relatively high in Santa Fe compared to the US average of 0.78 vehicles per person. This is not surprising since Santa Fe has about 33,000 commuters and only 450 commuted through public transit while almost 28,000 people rode private vehicles either alone or carpooling.<sup>19</sup>

## 2.1.2 Public Transportation in New Mexico

In New Mexico, there are multiple public transportation options. Some are offered and operated by the New Mexico Department of Transportation or other regional transit authorities, while the local city transit authorities control others. The different options

<sup>17</sup> Data from: Office of Highway Policy Information, 2014

<sup>18</sup> Office of Highway Policy Information, 2014

<sup>19</sup> U.S. Census Bureau, 2010

available to passengers include local city buses, regional commuter buses, commuter train, as well as a feeder system. In addition to the fixed route service, Santa Fe Trails also operates ADA complementary paratransit service, called Santa Fe Ride which is a form of DRT (See Section 2.2.2).

The regional buses, known as the *Blue Buses*, provide free transportation to nearby communities and pueblos throughout the counties of north central New Mexico including Los Alamos, Rio Arriba, Santa Fe, and Taos<sup>20</sup>. The *Railrunner* commuter rail runs from Santa Fe to Belen, south of Albuquerque, connecting the main cities of central New Mexico and smaller towns and pueblos along the way with a fast and reliable commuting option<sup>21</sup>.

## 2.2 Santa Fe Public Transit System

The city of Santa Fe offers different public services to move people around the city. As the main option, the Santa Fe Trails transit system offers two services: a fixed bus route system, and a DRT service (Santa Fe Ride) for those with disabilities or seniors and a third service, run by the city parking division that operates a free shuttle called Santa Fe Pickup connecting the commuter rail to attractions or points of interest in the downtown area. The combination of these systems makes it possible for people to travel all around Santa Fe with relative ease.

The Santa Fe Trails operates at around 11% capacity as shown in Figure 3. When compared to other bus systems in cities with similar population density in the United States, we can see that the Santa Fe Trails buses are underutilized.

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<sup>20</sup> NCRTD.

<sup>21</sup> Riometro.

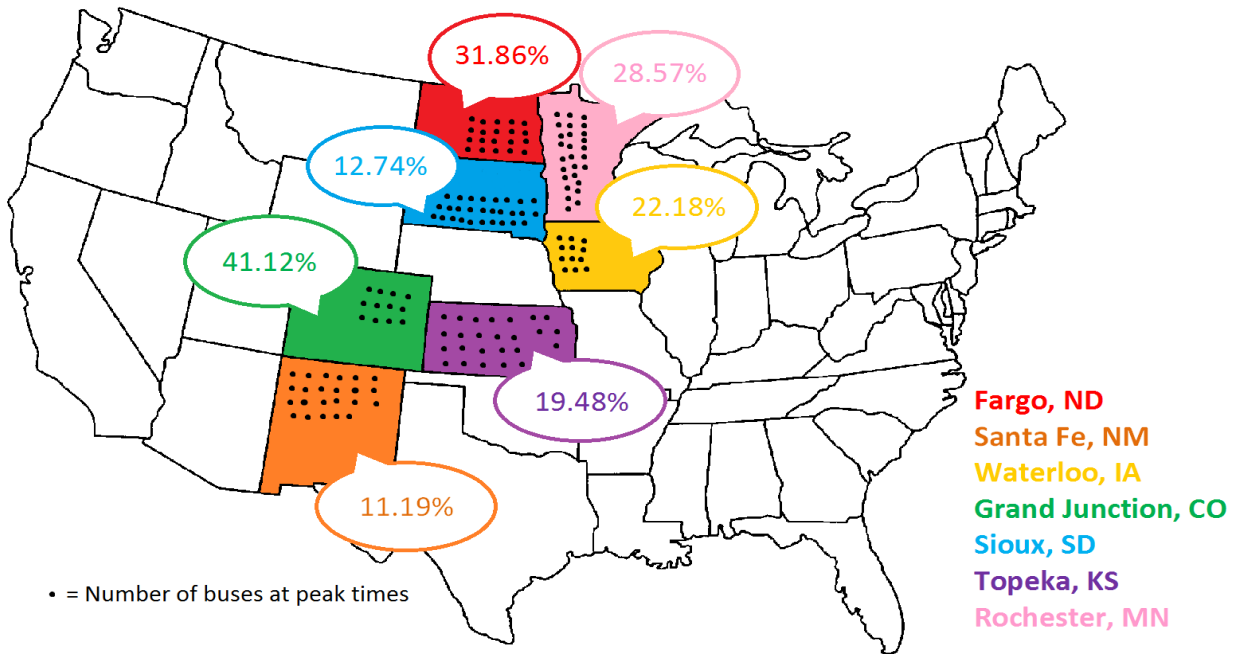


Figure 3: Percent Capacity in Low Population Density Cities<sup>22</sup>

All the cities detailed in Figure 3 have population densities between 1,000 and 3,000 people per square mile and only data for their fixed route bus system was analyzed.<sup>22</sup>

For each city the number of passenger trips per year was analyzed and using the number of buses that run each day and the number of trips each bus makes in a day, the number of people per bus per trip was calculated. Finally, this number was divided by the capacity of each bus to determine the percent capacity each day.

Santa Fe Trails had the highest annual operating budget of the similar low density cities. These and other stats are listed in the Table 1. Most cities compared to Santa Fe have more buses that operate for shorter hours. Santa Fe Trails operates almost twice as many hours as the next highest operating city (Rochester, MN). However, the longer operating hours do not translate to more passenger trips, causing Santa Fe to have the lowest passengers per hour and the highest operating budget. Overall, cities tend to have higher utilization if they operate fewer buses and/or at fewer times. The unusually high annual revenue hours is the primary reason Santa Fe Trails not able to reach even 20% capacity.

<sup>22</sup> Data from: Sioux Area Metro – Transit System Analysis, 2012

Table 1: Santa Fe Trails Operation Compared to Similar Population Density Cities<sup>23</sup>

Public Transit System Categories	Group Average	Santa Fe Trails	SF Trails Ranking
Number of Peak Buses	23	23	5 <sup>th</sup> (tied)
Annual Operating Budget	\$4,766,948	\$6,967,276	1 <sup>st</sup>
Annual Passenger Trips	1,396,541	1,074,024	4 <sup>th</sup>
Vehicle Revenue Hour	61,887	99,942	1 <sup>st</sup>
Revenue Hours/ Peak Vehicle	2,754	4,345	1 <sup>st</sup>
Passengers / Revenue Hour	22.05	10.746	7 <sup>th</sup>
Cost / Passenger Trips	\$3.55	\$6.49	1 <sup>st</sup>
Cost / Revenue Hour	\$75.19	\$69.71	4 <sup>th</sup>

### 2.2.1 Santa Fe Trails: a Fixed Route Bus Service

Santa Fe Trails uses a fleet of compressed natural gas buses, all of which are wheelchair accessible and provide bike racks with three-bike capacity. The fleet includes 35 buses, with only 23 in use on any given day<sup>24</sup>. In 2013, these buses transported an average of 2,800 passengers per day.

The fixed route system contains 10 routes that canvas the city and a small part of Santa Fe County, covering most of the areas with a high population density as shown in Figure 4. In the figure, areas in darker blue have a higher population density and each stop is represented by a dot. The system has 470 stops and runs from 6am to 10pm Monday through Friday as well as service to some routes on weekends.

<sup>23</sup> Data from: Sioux Area Metro – Transit System Analysis, 2012

<sup>24</sup> Santa Fe Trails, 2013

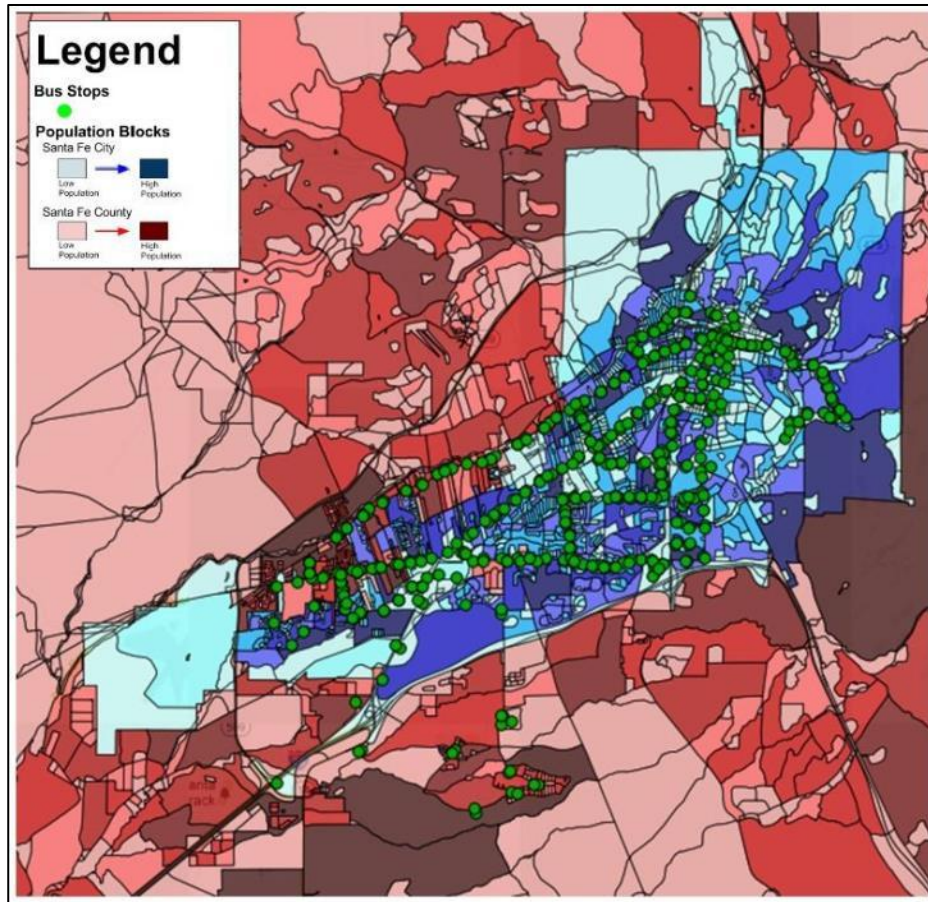


Figure 4: Santa Fe City and County blocks (shown in blue) according to population density with bus Stops (green dots)<sup>25</sup>

There are seven cameras on the buses which monitor the payment areas, interior, road ahead, and the curb side of the bus. Moreover, a GPS system allows live tracking of the bus through the “where’s my bus” link on the transit website. In conjunction with the mobile app currently in development, these technologies could provide useful information to bus users and managers.

With the great coverage and technologies available, riders can connect to museums, shopping areas, commuter buses and trains, and other areas of interest, like government offices. Naturally, some routes see large ridership while others get almost no usage. For example, in 2013 Route 2 had 52% of the annual ridership, whereas Route 26 only had 0.9%. This leads to higher revenue from some routes like route 1 or 2 and very low revenue

<sup>25</sup> Image from: Brevig, 2013

from others like route 26 or M as shown in Figure 5. This discrepancy is partially due to the areas covered by each route.

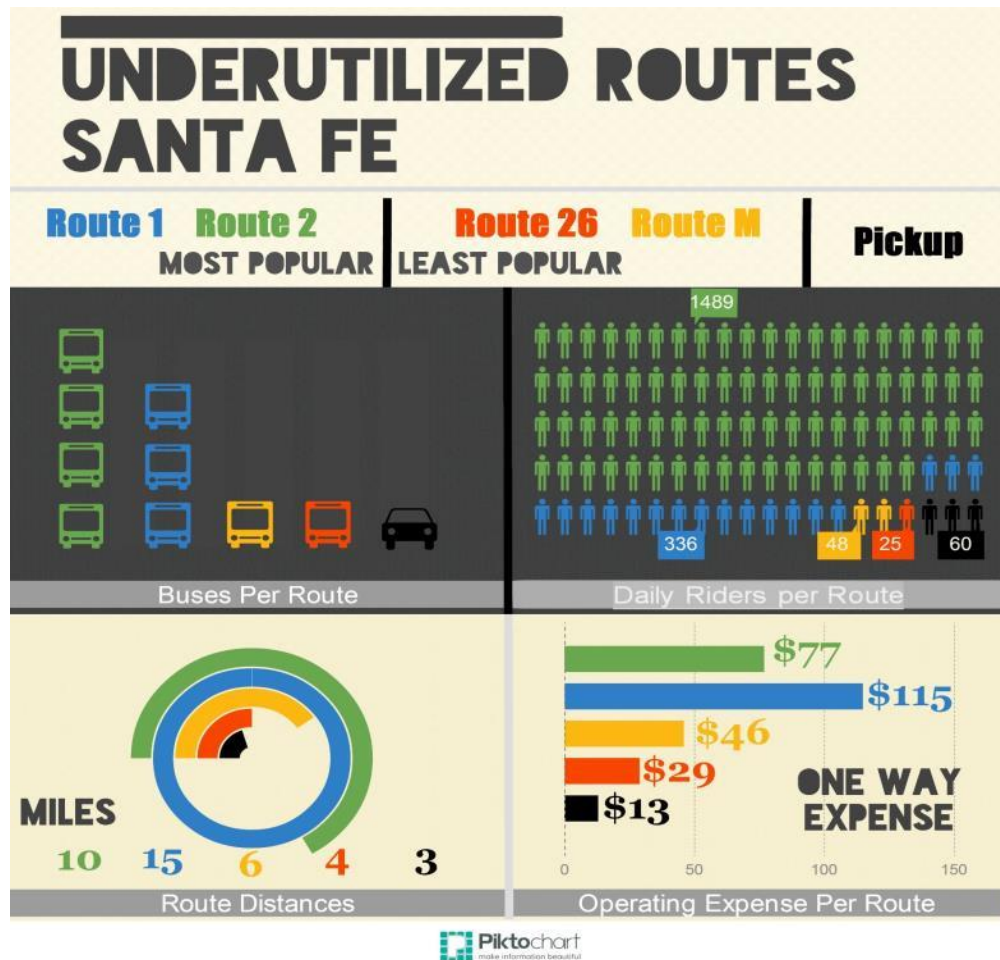


Figure 5: Ridership and expenses for most popular and least popular Routes and Pickup<sup>26</sup>

Since Santa Fe Trails' start in 1993, there has been continued growth in annual ridership, as shown partially in Figure 6, with the fixed bus route system seeing the most use. In 2013 it had 1,074,024 unlinked passenger<sup>27</sup> trips; a 4% increase from 2012 and a

<sup>26</sup> Data from: Santa Fe Trails, 2013.

<sup>27</sup> Unlinked passengers refer to the number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination

10% increase from 2011<sup>28</sup>. Although the population stayed roughly the same over the last 10 years, ridership is still increasing (See Figure 6).

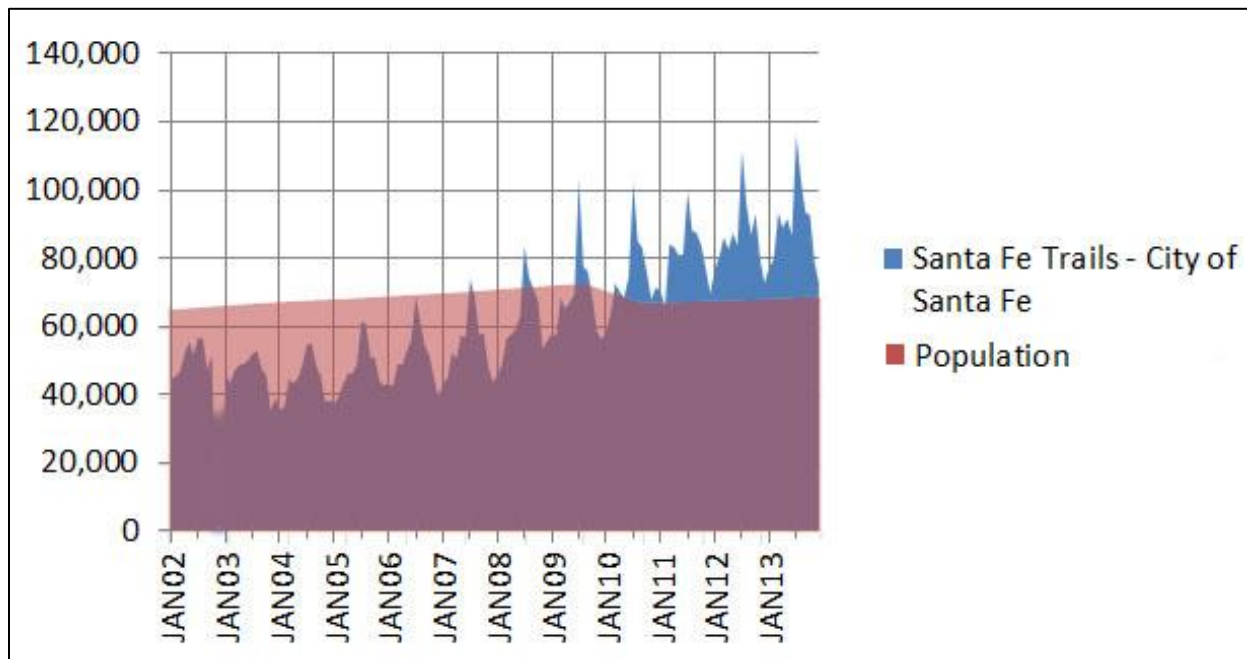


Figure 6: Fixed Route Ridership Data vs. Population change in Santa Fe as given on Santa Fe Trails National Transit Database Annual Report and American Census.

### 2.2.2 Santa Fe Ride: a Paratransit System

In addition to the fixed route service, Santa Fe Trails also operates an ADA complementary paratransit service called Santa Fe Ride. This service is for individuals with disabilities who cannot use the fixed route system, and seniors over 60. The former must submit an application and be certified as "ADA paratransit eligible," according to guidelines set by the Department of Transportation Americans with Disabilities Act. Certified customers may make reservations in advance, from the day before the requested trip up to 14 days in advance, by calling the Santa Fe Ride call center. Customer service representatives use RouteMatch software to book the reservation, and schedule and dispatch vehicles. The Santa Fe Ride service operates during the same hours and days as the fixed route service, and is available for trips with an origin and destination

<sup>28</sup> Santa Fe Trails, 2013



within 3/4 mile of any fixed route (per Federal rule), as well as anywhere within the city limits outside the 3/4 mile (per City policy)<sup>29</sup>.

### **2.2.3 Santa Fe Pick up: a Downtown Shuttle Service**

The Santa Fe Pick-up runs in a fixed loop connecting the downtown commuter rail station to attractions and points of interest in downtown (For route map see Appendix J). It is free to ride and most commonly used by *Railrunner* passengers traveling to downtown, museums, hotels, or the Santa Fe Trails bus lines. The shuttles run Monday through Friday from 6:30 a.m. to 6:30 p.m. and Saturday from 7:30 a.m. to 4:30 p.m. with no Sunday service. A seasonal route to Museum Hill and the Children's Museum starts May 1st and is serviced through the second week in October. These are run upon request from 10 a.m. to 2 p.m. Funding for the shuttle service is provided by an annual grant from the North Central Regional Transit District (NCRTD) and is currently run by the Parking Division.<sup>30</sup>

### **2.2.4 Colleges Serviced by Santa Fe Trails**

There are four major colleges inside the city of Santa Fe. The first is St. Johns which is located in northeast Santa Fe and has a student population of about 500.<sup>31</sup> It is serviced by the M line of the fixed-route service which stops next to the college with a frequency of one bus per hour from 7am to 8pm on weekdays and 10:30am to 5:30pm on weekends.<sup>32</sup>

The Santa Fe University of Art and Design is located in central Santa Fe and has a student population of about 850 students.<sup>33</sup> The closest bus stop is located on Cerrillos Rd as part of Route 2. Route 2 runs with a frequency of 15 minutes during peak weekday times and 30 minutes otherwise from 5:30am-10pm on weekdays, 8:30am-8pm on Saturdays, and 9am-6:30pm on Sundays.

The Institute of American Indian Arts has about 500 students. It is serviced by Route 22 which has a stop in front of the campus. This route runs on weekdays from 7:30am to 6:30pm with a frequency of about 80 minutes and has no service on weekends. IAIA does offer a shuttle to its students but it makes only four trips a week with no set route. It stops at

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<sup>29</sup> Santa Fe Trails, 2014

<sup>30</sup> Santa Fe, New Mexico, 2013

<sup>31</sup> St. John's College, 2014

<sup>32</sup> Santa Fe Trails, 2013

<sup>33</sup> Santa Fe University of Art and Design, 2014

various locations on different days and the student must make arrangements with the driver to get picked up as the return route and time is not set. It is also available by request but the appointments must be made in advance and can only be used for medical appointments, internships, or employment.<sup>34</sup>

The last college is the Santa Fe Community College. It is by far the largest with 6,600 students. However, it is also the only one that has no on campus housing. All of the students at SFCC are commuters and over 70% are part time students.<sup>35</sup> It is serviced by both Routes 22 and 21. Route 21 runs from 7:30am to 9:30pm with a frequency of 70 minutes and it also does not have any service on weekends. This creates a need for service to the college as it does have many classes on nights and weekends and does not have any sort of shuttle system run by the college.

## **2.3 Challenges Faced By Santa Fe Trails**

When using a public transit system, there are certain elements that we take for granted. For example, when riding for the first time we automatically try to decipher where in the system we are located, which direction we need to head, and when the next bus or train will arrive. Usually this information is found on maps, signs, websites, or through mobile applications, and are supplied by the transit companies. The Santa Fe Trails system is no different, however information needs updating to suit current rider demand. In many cities the “first and last mile” problem is a significant obstacle for public transportation. In a widespread city like Santa Fe, the problem is even more apparent since the distances are higher and the population sparse.

### **2.3.1 Rider Information**

Bus stop signs, websites, route maps, schedules, etc. all fall under rider information that is provided by the transit company. By comparative analysis, a WPI project group evaluated the information available at most bus stops in Santa Fe in 2013 and found it to be inadequate at best; the signs were deemed difficult to interpret and did not provide users with precise information for every bus stop, only displaying major stops and leaving the rider

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<sup>34</sup> IAIA, 2014

<sup>35</sup> SFCC, 2014

to interpolate in between times<sup>36</sup>. Currently in Santa Fe, there are three kinds of bus stop signs. The first are signs that just indicate the presence of a bus stop but do not indicate



Figure 7: Old Bus Stop Sign (Left) & Updated Bus Stop Signs with Schedules (Right)

which route(s) there are along with no indication of the schedule for that bus, as shown in Figure 7 (left). Some of the signs have been updated with a schedule wrapped around the sign for the bus route that stops there as shown in Figure 7 (right).

Although this type of sign is an improvement it does not indicate where that stop is in relation to the entire schedule. The most updated signs contain a schedule, a

map of the routes and other helpful rider information as well as a culturally designed shelter as shown in the city.. These bus stops are in the process of being added to more areas around the city. The website provided minimal information besides bus schedule and users had to call in order plan trips through public transportation.



Figure 8: New Bus Stops with Route and Schedule Display

In comparison, the Denver public transportation system is a great model for public transit rider information. From a survey in 2008, about eight out of ten bus riders (86%) rated the bus service as either excellent (34%) or good (52%)<sup>37</sup>. The system was applauded for convenience provided in the form of closeness of bus stops to origin and destination. In regards to customer information, Denver public transit

<sup>36</sup> Brevig, Kai, 2013

<sup>37</sup> The Howell Research Group, 2008, p 29

provides route information at bus stops, options to receive schedule information through telephone or mobile device, and online access. An example of the Denver bus stop signs is shown below in Figure 9. All the stops have a unique ID through which riders can access the scheduled arrivals times for any buses on that stop.



Figure 9: Denver bus stop sign with bus stop identification numbers pointed out

The survey respondents overwhelmingly rated the ease of understanding the bus schedules as good to excellent (80%). The quality of route information at bus stops was rated lower as only 59% of responders found it be good or excellent, but only 17% found it to be poor or lower quality. Finally, the Denver transit website received an 86% good or excellent rating<sup>38</sup>. Their public transit website provides users with the ability to plan trips based on trip planning abilities of Google Transit. The bus schedules online provide users with the ability to filter times by just their starting and ending stops among other filtering options like eastbound/westbound, making it much simpler for users to look for bus times<sup>39</sup>.

### 2.3.2 The First and Last Mile Problem

What is commonly referred to in transportation as the “first and last mile problem” is the difficulty in reaching a bus stop from your origin or destination, and vice versa<sup>40</sup>. The first and last mile problem exists in all major public transit systems and consequently many systems have come up solutions. These solutions range from rental bikes, personal rapid transit systems, carpooling programs, feeder systems, and finally urban planning<sup>41</sup>.

<sup>38</sup> The Howell Research Group, 2008, p 40

<sup>39</sup> Regional Transit District, 2014

<sup>40</sup> Chao, 2010

<sup>41</sup> Kuang, 2009

The different solutions to the first and last mile problem are devised to tackle various sprawls of cities. European cities, for example, overwhelmingly make use of shared rental bikes. Bike sharing allows a user to pay to rent a bike from a designated station and return the bike to the same or a different station once they are finished with the bike. The largest and most popular of these programs in Europe is the Vélib of Paris with 20,000 bicycles and 1,650 stations. Asia is now the fastest growing market for bike sharing with Hangzhou, China having the largest bike sharing program in the world<sup>42</sup>. Finally, the most popular bike sharing program in US is the Capital Bikeshare in Washington DC with some 1,100 bikes at 100 stations.

Personal rapid transit programs make use of on-demand services to carry small numbers of passengers. One such program is the driverless Pod Cars that take London Heathrow passengers to parking lots. This system ferries 800 people along 2.4 miles of track daily. Research on such solutions is being carried out in many cities of the US, including San Jose CA, Ithaca NY, Raleigh NC, and Hillsboro OR.

Carpooling is another popular solution, and is benefiting from mobile computing and online social networks. Different companies like GoLoco, Ride.Link, Avego Shared Transport are releasing applications which alert drivers and potential ride partners when they are near each other. However, these ride-sharing programs are still in preliminary phases and depend heavily on technology<sup>43</sup>. A non-technological precursor to these carsharing apps is Sluglines in the Washington DC area, where people share rides by pulling off highway exits to pick up passengers that allow them to use the HOV (High Occupancy Vehicle) lanes. Finally some US cities are so spread out that most solutions are too expensive to implement. In such a situation, a combination of solutions is required to make mass transit ubiquitous, which is where urban planning comes in. Settlements can be designed in a way that public transportation usage can be maximized.

Another solution for the first and last mile problem is a feeder system. These systems are characterized by having flexible routes and times. While they are more expensive than a fixed route system, they have higher usage and are very useful in places that have a low demand or low population density. Feeder systems vary in design, from

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<sup>42</sup> Shaheen, 2010

<sup>43</sup> Kuang, 2009

those where vehicles travel a specified route to ones which run completely based on individuals' needs. Table 2 shows different variations of what feeder systems can contain.

Denver has a popular feeder system known as *Call-n-Ride*. It is a personalized bus service that needs advanced reservation. It can take passengers to any location they desire within the service radius for \$2.25 (regular fee). *Call-n-Ride* services the city of Denver and surrounding areas, serving 500,000 people in 2013.

Table 2: Denver Call-n-Ride coverage area and population in that area

Denver Call-n-Ride Name	Coverage Size (miles <sup>2</sup> )	Population
<b>Arapahoe</b>	4.97	17,649
<b>Belmar</b>	6.8	27,853
<b>Broomfield</b>	6.8	10,582
<b>Evergreen North</b>	3.6	5,306
<b>Federal Heights</b>	8.45	42,336
<b>Highlands Ranch</b>	11.56	49,363
<b>Inverness North</b>	2.1	2,000
<b>Lone Tree</b>	5.1	8,103
<b>Louisville</b>	5.1	13,178
<b>Orchard</b>	2.2	6,436
<b>South Jefferson</b>	11.56	12,458

Out of all the public transit services, Call-n-Ride received the highest customer satisfaction at 91%, with almost 80% citing commuting to or from work as their primary purpose of use. The service runs on time, serves the area desired by customers, and is easy to schedule.<sup>44</sup> From Table 3 below, *Call-n-Ride* is an example of a continuous multi-hire service.

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<sup>44</sup> RTD, 2011.

Table 3: Comparison between fixed transit system, demand response, and taxis for various categories.<sup>45</sup>

Characteristic	Mass transit (bus)	Demand- responsive services			Single hire taxi
		Route deviation	Flexible route		
			Area- based services	Continuous multi- hire services	
Timetable/ schedule	Fixed	Usually uses a timetable with specific departure times. Timetable includes an allowance to cover any deviations	Can be operated at particular times (eg every 30 minutes) or as required	No timetable – operates purely in response to demand	No timetable – purely on demand
Route/origin – destination	Fixed	Fixed, but with deviation to allow pickup/set- down off- route	No route, but covers a specific catchment area, usually with one or more fixed points	Anywhere to anywhere within a given zone or service area	Anywhere to anywhere, no route
Typical vehicle	Bus	Conventional bus or smaller (midi/mini bus)	Small bus or maxi taxi	Maxi taxi or multi- hire taxi	Standard taxi
Typical operator	Bus company	Bus company	Bus, taxi or community transport	Taxi operator, community transport	Taxi operator
Typical fare structure	Standard bus fares	Bus fares, possibly with supplement for door- to- door service option	Zone- based fare	% of single- hire fare, or fixed based fare on origin and destination	Based on meter (flag fall plus distance plus time)
Typical application	Mass transit	Low density area and/or low demand periods	Special needs customers	Affordable, flexible transport	Individual transport
Booking system	None	Required for customers wishing to be picked up off the fixed route	Required for all customers except those at key stops	Essential for all customers	Required except for hail or rank trips

Santa Fe Pickup is an example of route deviation listed in Table 3. However, the Santa Fe Trails is planning to pilot test a flexible route system. In 2013, a WPI study conducted for the Santa Fe Trails proposed a similar system and the authors suggested a certain coverage area that the “feeder” system would cover (Figure 10).<sup>46</sup>

<sup>45</sup> Data from: RTD, 2011

<sup>46</sup> Brevig, 2013

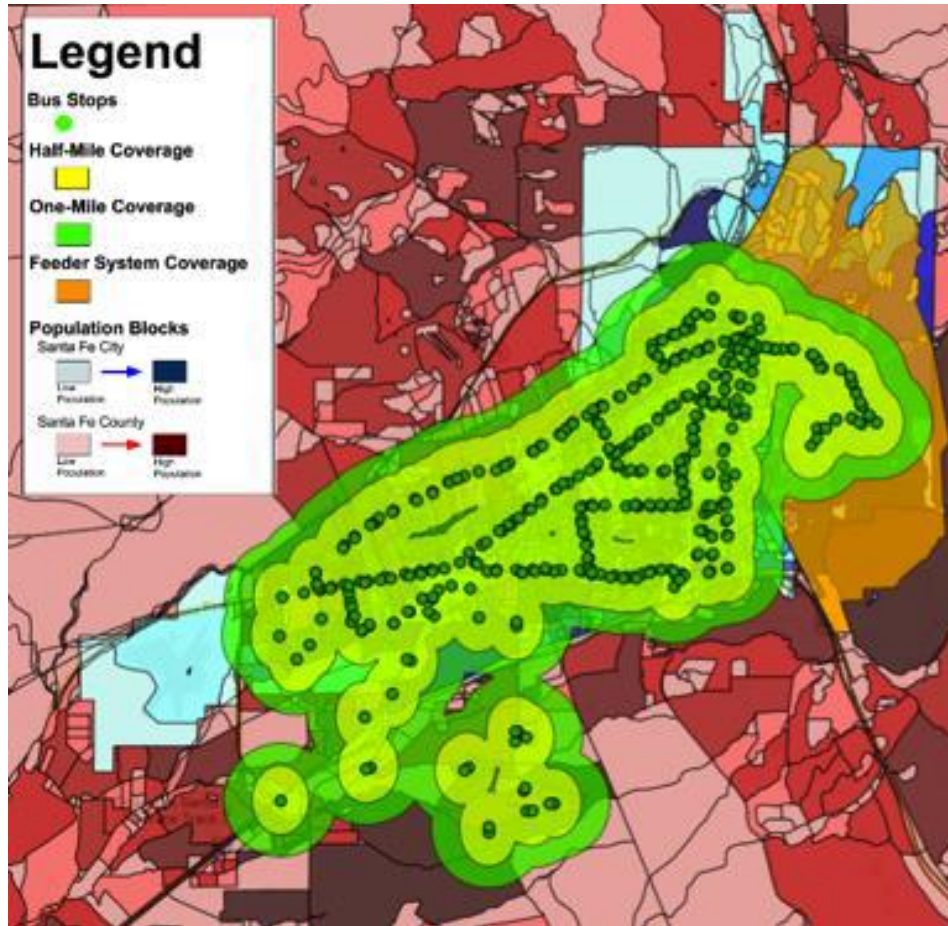


Figure 10: Proposed feeder system coverage<sup>47</sup>

They also suggested that the system be run in a way that reservations can only be made with a bus stop as either a pick up or destination to eliminate the possibility of people using it as a taxi type service. Anyone who wants to use the system would have to call into a dispatcher who would make sure that the caller was inside the approved range. The caller would then be able to have their trip planned and be told the projected wait time until the van would arrive to pick them up. The existing mobile app could also be used to accomplish this task. In order to have the resources to run this, the previous study that was done suggested that unused paratransit vans, preferably two, would be used to run this new feeder system.

<sup>47</sup> Image from: Brevig, 2013



### 2.3.3 Mobile Resources

As smartphones and mobile technology become an integral part of our personal lives, businesses and services need to adapt. Many transit systems across the US utilize mobile applications to facilitate users, including ticket purchases, schedules, and even live tracking.<sup>48</sup> An example app with a variety of functionality is the one available for the Boston bus system (MBTA) called T Live. It allows riders to view a map of the functioning bus system, choose all the routes available on the system, as well as the bus stops related to each route. Finally, predicted arrival times are given for any selected bus stop. A unique feature is that the app allows users to find nearby attractions as well as sound an alarm when the rider reaches their bus destination<sup>49</sup>.

The Santa Fe Trails has partnered with *AppCityLife* to develop a transit app. This app will be modeled after the main transit app in the city of Albuquerque, NM known as *ABQride* shown in Figure 11. Provided there is enough data, the following are the potential features offered by the app developers:

1. Live Bus Tracking for any given route
2. Push Notification for last minute information and any updated necessary for a selected trip or their favorite route.
3. Links to different web sources that complement the needs of the riders for example, other transit app available for the city, links to buying rail runner pass etc.
4. Bus schedules for fixed bus routes.
5. Bus stops near the current location of the user.
6. Fare calculator for different length of times as well as any discounts like student, elderly.
7. Plan your ride, which would allow users to get a detailed trip and transfer times similar to those offered by Google Maps.
8. Local coupons, allows users to reap the benefits along their route and provide revenue to Santa Fe Trails through the coupon placements.
9. Bike racks availability which will inform users if there are bike rack spots available on their selected bus. This feature is stringent on whether sensors can be implemented on buses or if the crowdsourcing feature is popular.

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<sup>48</sup> Yelton, 2012

<sup>49</sup> Choephel, 2014.



Figure 11: ABQRide with route options on left and live bus tracking on right

## **3. Methodology**

The goal of this project is to assist the Santa Fe Trails' efforts to increase utilization by exploring rider feedback, current utilization, and rider information to determine feasible recommendations. We accomplished our mission through the following objectives:

1. To assess and improve the quality of information available to riders
2. To assess the current level of utilization
3. To propose system improvements by redistributing resources

This project focuses on the Santa Fe Trails bus system and the information and services available to riders. We collected data from March 24, 2014 to April 17, 2014 and we also analyzed data collected in previous years. Our project required data to be collected at representative times of the day and all days of the week, including weekends, when the system was running. Even though we were only in Santa Fe for a short time, we extrapolated our data to a yearly-basis using data from previous years to get an idea of how the system functions year round. See 8.7 Appendix I for a detailed calendar of our data collection efforts.

### **3.1 Assessing and Improving Information**

One of the obstacles that riders of public transportation face is being able to understand the system without much effort. Knowing how to read the bus schedule, knowing where the rider currently is and where they need to get off and being able to understand the information on the bus stop sign are all needed in order to ride the bus. Unfortunately, either the lack of information available to them or the poor organization of the information, both of which may make it hard to understand and utilize the bus system, often discourages many riders. Information can be presented tangibly like bus stop signs and schedules or digitally with SMS texting.

#### **3.1.1 Tangible Information**

The tangible information of the bus system includes the bus stop signs, route maps and the schedules associated with each route. These are currently confusing to many riders because there is not enough information available to riders to allow them to understand and utilize the system.

Our goal was to gather feedback from riders about the new shelters, maps and signs to determine if anything was confusing or missing. We accomplished this by talking to riders at these new bus stops in person and taking notes on what they told us could be improved upon. We also gained some bus stop feedback from riders through a survey taken by riders on the bus (8.1 Appendix A). We distributed surveys on all 10 routes from Thursday March 27 to Saturday March 29 (8.7 Appendix I). In total 500 surveys were distributed; 400 English and 100 Spanish. The distribution for each route is shown below in Figure 12.

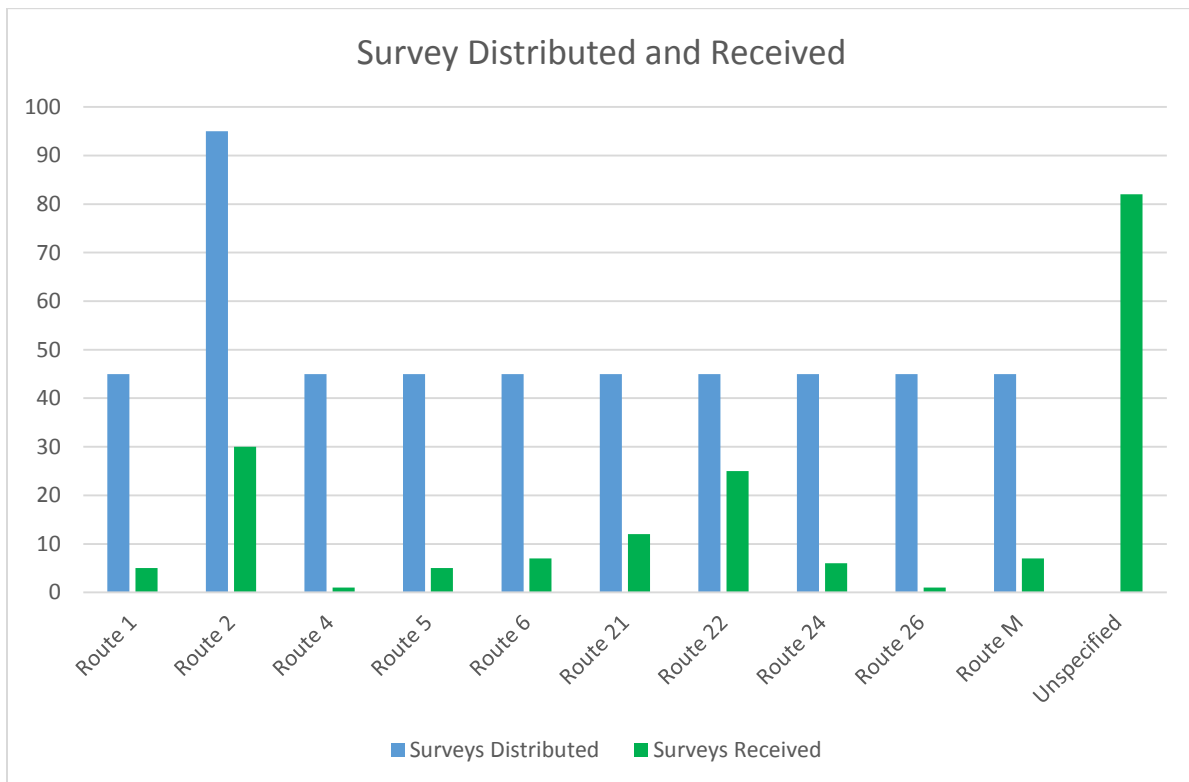


Figure 12: Number of surveys distributed and received for each route

### 3.1.2 Digital Information

The digital information of the bus system includes the possibility of SMS texting capabilities. The information associated with this technology can be improved to make the system easier for riders to understand and to gather current information about their bus.

### **SMS Texting**

SMS texting is a system where users can text a code to a specific number and they will receive a response with information about a specific topic. If implemented in Santa Fe, a rider could text a specific code that corresponds to the bus stop they are at and receive information about when the bus will arrive and where it is headed. Our goal is to create a sticker that can be placed on every bus stop sign that will have a code and number to text that will give information about that bus route. We assessed the desirability of an SMS system in Santa Fe by asking riders for their opinion on the subject, as part of our surveys.

## **3.2 Assessing the Current Level of Utilization**

In order to propose changes to Santa Fe Trails, we first needed to understand current utilization levels. To achieve this, we distributed surveys among fixed route passengers, made our own observations, and interacted with passengers and drivers for feedback.

### **3.2.1 Surveys**

The survey was made to gain a more comprehensive picture of passengers and their experiences. The questions cover demographic data, basic utilization understanding, and user-experience specific questions.

Although the survey covers a broad range of data, basic utilization questions were analyzed to understand why passengers use the system, how they access it, and if the service they had was satisfactory. The other questions focusing on user experience and information were analyzed in their appropriate sections. The full set of survey questions can be seen in Appendix 7.1.

The surveys were distributed to all the fixed bus routes and collected over a three-day span, including one weekend day. In addition to providing us basic passenger demographic data, the surveys also collected data on *why* passengers utilize the system (purpose of trip), their commute outside of the bus system, and satisfaction and feedback with regards to the bus service.

In order to facilitate more responses, the questions were made multiple choice or check boxes, with simple vocabulary, as well as a Spanish version for passengers who did not speak English.

Once collected from the bus drivers, all surveys were inputted into a master excel spreadsheet, with each survey receiving a unique identification number.

### **3.2.2 Monitoring rider behavior on SFT routes**

In addition to the surveys, we needed to experience the bus system first hand and gather physical observations that complemented the surveys. We conducted observations on Lines 2 and M (Appendix H), using the observation forms (Appendix B) to capture trip and stop information. At each stop we determined how many passengers got on and off, how they paid, their age, and for each passenger we collected boarding and disembarking stops, tracking their overall trip from origin to destination.

The forms also helped to maintain consistency of data since the only questions that allowed for discrepancies were the age and bus stop name. For each we established a system to eliminate errors. For the age group, if the passenger didn't pay, they were a minor, since minors ride free of charge; if they were elderly in appearance or paid a reduced fare, then they were classified as a senior; and any passenger that did not fall into those categories was marked as adult. To ensure we used the same bus stop names, during observations we marked cross streets or landmarks and before we inputted all the data into a master spreadsheet, we first made a key of all bus stops, with landmarks and cross streets, and converted all our bus stops into cross street names.

While collecting observations on route 2, the team split into two groups and worked in shifts, each collecting data on morning or afternoon peak hours, 6-9 a.m. and 4-6 p.m., respectively. For each shift (morning or afternoon) data was collected on two round trips, meaning two inbound and two outbound trips, per team. This was done for three consecutive weekdays. For route M, the team followed a similar schedule; however we rode only from 12-1 on two days. The calendar in Appendix 7.7 shows the specific days and times for each of our observations.

We used the data to determine the busiest or most frequented stops on the studied routes, the type of rider (commuters, students, elderly, etc.) and their origins and destinations.

### **3.2.3 Interactions**

Our final method that assessed current utilization was to interact with passengers and drivers. We carried out brief, informal interviews at bus stops or on the bus, during which we asked questions to determine how passengers felt towards the overall services provided, including if they would use an express bus or DRT system, how the system could be improved to suit their needs, or other general feedback they might have. When approaching a rider, we would ask if they wanted to answer a few questions or we pretended to be ignorant to the overall system.

When asking drivers, we focused more on logistics or operations, since they have the best understanding of how the system runs. This meant asking questions such as busiest times of the day, how they would change the system and route restructuring. We then conducted more observations to explore and validate the feedback we received from both passengers and drivers.

## **3.3 Analyzing System Improvements by Resource Redistribution**

New services that cater to customer demand could have a significant impact on business, even if the changes are simple. Besides augmenting the quality of information available to riders, we are exploring resources that would make the Santa Fe Trails bus system more accessible and practical without incurring additional costs by shifting existing resources for new tasks.

### **3.3.1 Feasibility of a Feeder System**

Based on the suggestions from the study done last year, Santa Fe Trails wanted us to do additional research on a feeder system. The recommendation from last year was to have the feeder system only run to bus stops from within a set area shown in orange in Figure 10. This recommendation was made based solely on where large numbers of people were not served by public transit. Our research into the economic and population distribution of Santa Fe yielded a different area for the feeder system. We found the economic and population map of Santa Fe, and combining them into one (bottom left of Figure 13). This proposed set area is shown in bottom right of Figure 13. We took into

account the economic condition of the population and assumed that the feeder system is more likely to be used by the lower half of the social economic spectrum. From that assumption, we identified areas that were not within a mile of a bus stop and marked them as possible locations for future feeder pilot tests. This feeder system would pick up passengers from their homes in the selected area and drop them off at the nearest bus stop.

For the pilot test, we originally intended to use the Downtown Transit Center as the only destination passengers could use. Then from this central point, people could either ride in the feeder van to their homes or from their homes to the central point. This feeder van would have covered a 3 mile radius from the downtown transit center.

## Where is the bus needed?

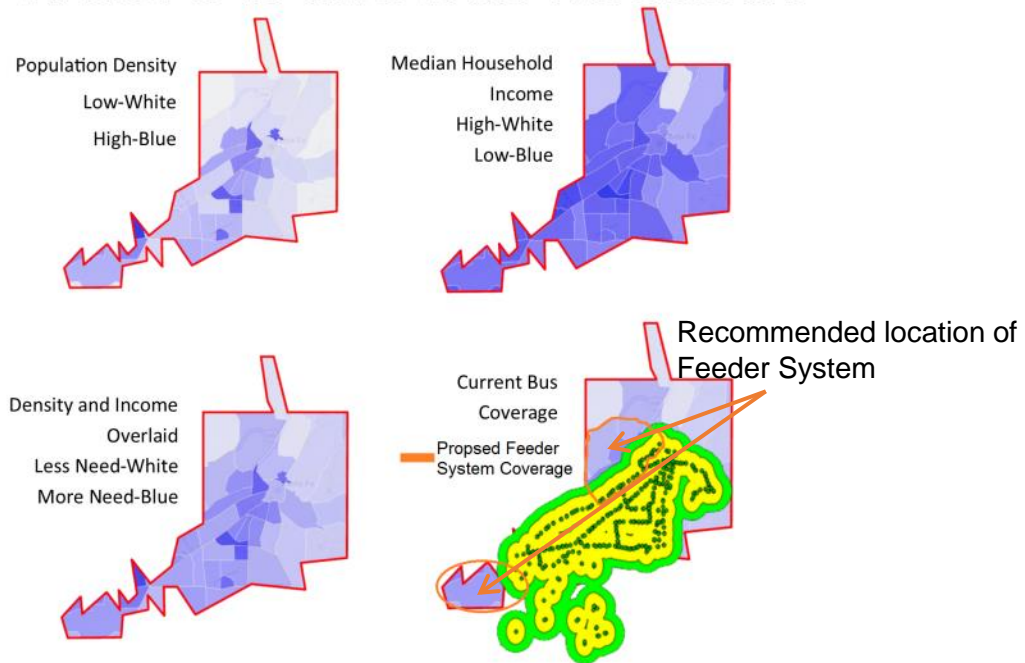


Figure 13: Economic Distribution in the City of Santa Fe

As a model for this system, we made use of an existing system very similar to feeder systems. The Fort Marcy shuttle is an on-demand van that takes people from the Fort Marcy Suites to any destination of their choosing within approximately 2-3 miles from Fort Marcy. The shuttle runs from 8 am – 4pm on weekdays only. We used the Fort Marcy



Suites as a stand-in for the Downtown Transit Center, which is where a future feeder pilot test could be centered. With this system already in place, it was easy to collect data that would allow some preliminary insights, including:

1. Call time during the day for the Fort Marcy Shuttle.
2. Pick up time or the how long the person had to wait after their call if it was as-soon-as-possible call.
3. Destination/arrival location (whichever was different from Fort Marcy)
4. How many people per call.

From the Fort Marcy shuttle data, we attempted to learn the approximate wait times after calling that users are subjected to. This will allow any future pilot tests in the area to locate their van resting area to model after such wait times. In addition, the time of day is also important from this data set as future pilot tests could get some insight into when a feeder system is most needed. Finally, an average travel time is important as it gives some information on how large a feeder system area should be. This data collection period ran from April 8<sup>th</sup> to April 18<sup>th</sup>.

We compared our data to the Denver Call-n-Ride system described in Section 2.3.1. We began this data collection by emailing the Denver Public transit to inquire about reports they have collected on customer satisfaction for their system. After that, we requested more information related to their solution for first and last mile problem. Their reply mainly focused on bike sharing programs that Denver has implemented as described in Section 2.3.1. Finally, we asked them a series of questions regarding the on-demand feeder system Denver owns. Regarding this system, our questions primarily focused on the purpose of Call-n-Ride, the operational cost of Call-n-Ride, and any shortcomings the system may have. The results from this informal interaction are provided in the results. We took the data from Denver and recommended a pilot test for a feeder system in Santa Fe.

### **3.3.2 Experimentation with an Express Line on Bus Route 2**

Referring to Figure 5 we see that route 2 carries over 50% of the annual ridership so, the buses on Route 2 tend to be overcrowded, especially during peak times of commuter travel. From our surveys and observations outlined in the previous sections, we extracted the most frequent origin and destination stops, time of day, and average daily passengers. This aided in identifying trends we used to design solutions to address both the overcrowded and underused buses.

Adding an express bus on Route 2 could provide an option for daily commuters to arrive at their destination faster and alleviate some of the stress on that route. To test an express bus, we utilized the bus and driver at our disposal to actually implement a pilot test with real riders.

First, we used the data on boarding and disembarking from our observation data to identify the stops that were used most. We mapped out distances between stops and number of passengers that got on or off at each stop. Any stops that were within a 3 minute walk got combined into the more popular stop and only stops with more than 10 riders were considered. We settled on twelve stops that we included on the express route from our results. We chose to run the bus for three days between the hours of 7-9AM and 4:30-6:30PM to target commuters trying to get back and forth to work. We took down data on time points for all stops and the number of riders boarding or disembarking at each stop during the pilot test to use for evaluation. A survey was given to each person that rode the express bus to gather feedback from actual riders (See Appendix C). This feedback was then used to propose a full system for Santa Fe Trails.

## 4. Results

In this chapter, we present the results we obtained for each objective. First, we present results pertaining to rider information. Next, we show the results of our system utilization assessment. Finally, we present proposed system improvement results.

### 4.1 Assessment of Rider Information

We collected a total of 182 surveys from all the routes with only one survey that was completely irrelevant. All the data was compiled in an excel spreadsheet and then filtered by response.

The survey data indicated that, when asked about the new signs and shelters, most people find them easy to read and understand (Figure 14).

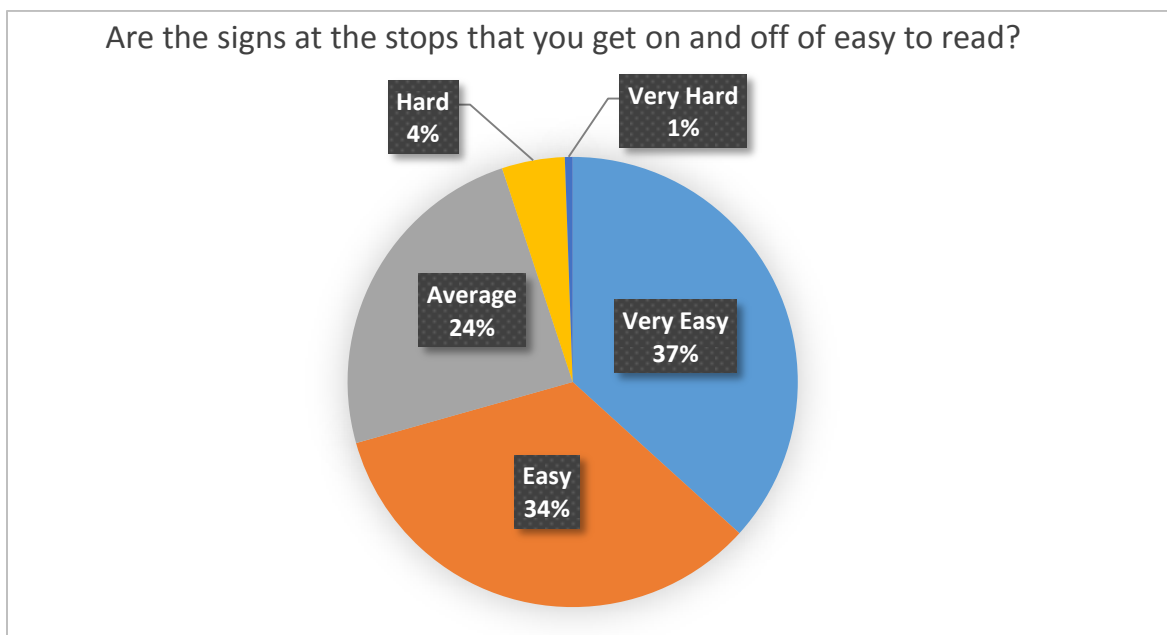


Figure 14: Survey responses on how easy it is to read and understand the signs at bus stops (N=177)

Another question that was asked in the survey was whether or not riders ask the bus drivers for information, whether about where a passenger should get off or how to buy a pass. A lot of people answered that they have requested information from the bus drivers (Figure 15) and of those people the majority of riders were satisfied with the customer service provided by drivers (Figure 16).

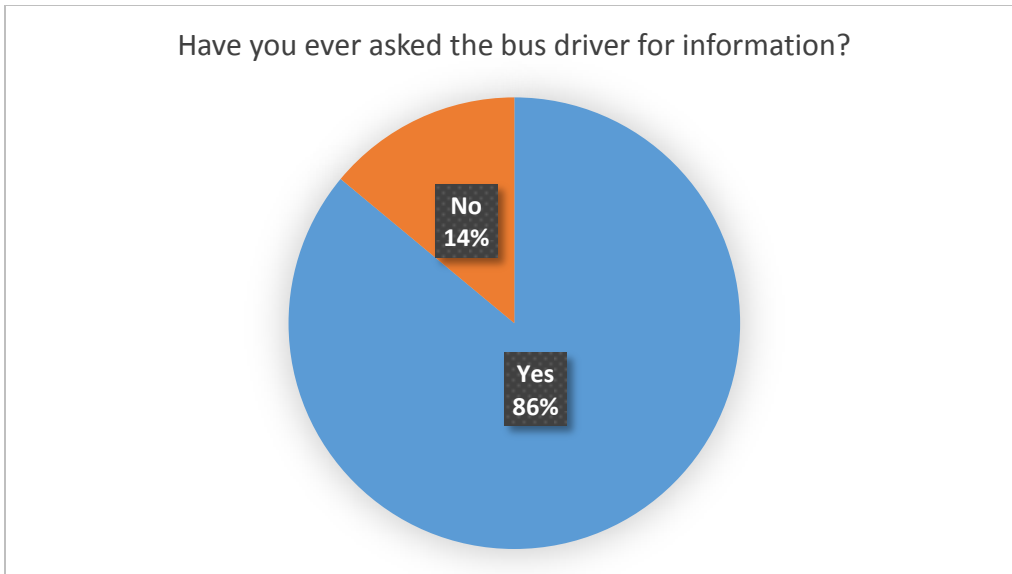


Figure 15: Survey responses on whether or not passengers have ever asked the bus driver for help (N=179)



Figure 16: Survey responses on whether or not passengers were satisfied with help received from bus drivers (N=163)

When asked about using a smartphone to access Santa Fe Trails information, a substantial fraction of respondents (22%) indicated that they do not have smartphones. Almost half of the respondents (45%) did not use a smartphone to access bus information from the website, though presumably they owned one (Figure 17).

Do you use a smartphone to access bus information?

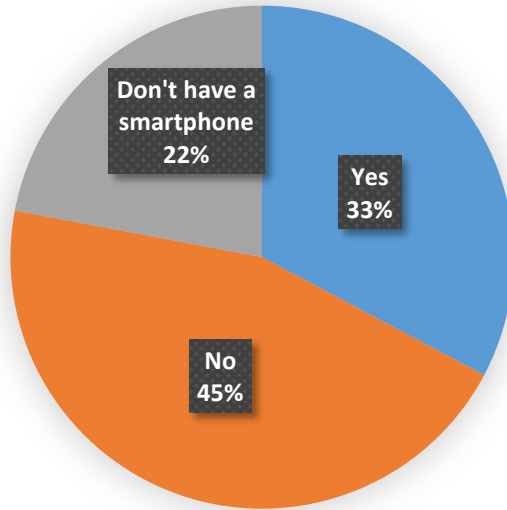


Figure 17: Survey responses on whether or not passengers look up bus information on their phone (N=177)

A third of the riders reported using their smartphones to look up information (Figure 17), mostly to look for routes and schedule information and holiday schedule changes (Figure 18).

What information do you look up on your smartphone?

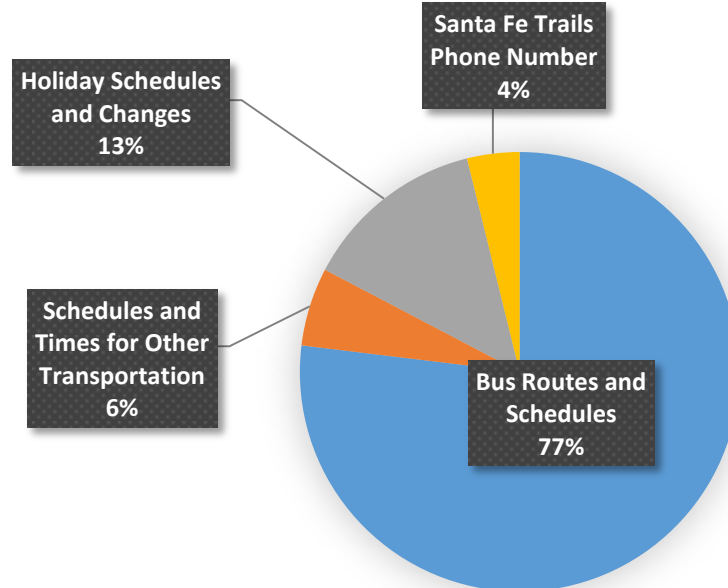


Figure 18: Survey responses on the type of information smartphone users' access (N=52)

The last question that we asked on the surveys was whether or not respondents were interested in a text message service that would give information on arrival time of the next bus. The majority of people (62%) did say that they would welcome a text message service, but almost 40% of respondents reported that they would not (Figure 19).

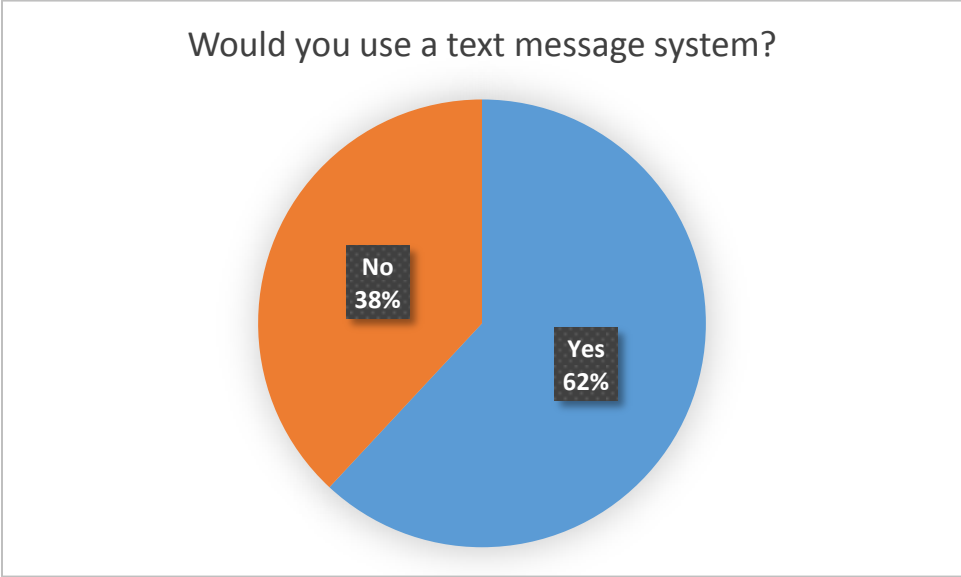


Figure 19: Survey responses on whether or not passengers would use a texting messaging service (N=176)

In addition to distributing surveys we also gathered feedback through one-on-one interactions with bus riders at various stops. One thing that many riders thought would be helpful would be a “you are here” sticker on each of the stops. Riders that have used the system many times are used to it, and do not look at the signs anymore, but many have encountered tourists that have asked them questions about the bus system and how they can get around Santa Fe.

## 4.2 Assessing the Current Level of Utilization

Understanding current utilization levels through our surveys, observations, and interactions yielded the following data. Our survey gathered data on system utilization. Here, we were interested in not only how people ride the bus, but why they ride the bus. Specifically, we asked questions on when riders commuted and the frequency of use, how long their trip to and from the bus stop took, why they rode the bus, and how satisfied they were with the overall system. Observations allowed us to see what the most popular stops on route 2 are, as well as passenger demographics.

## 4.2.1 Time of Commute

We first used the survey data to identify any differences in time of use patterns for commuters as compared with irregular riders. Figure 20, below, shows that passengers who ride the bus every day reported riding it at any time of the day, meaning there is no specific time or “peak hours” (i.e. morning or evening) that they ride. However, riders who ride every week or only some days per week exhibit widespread times of use.

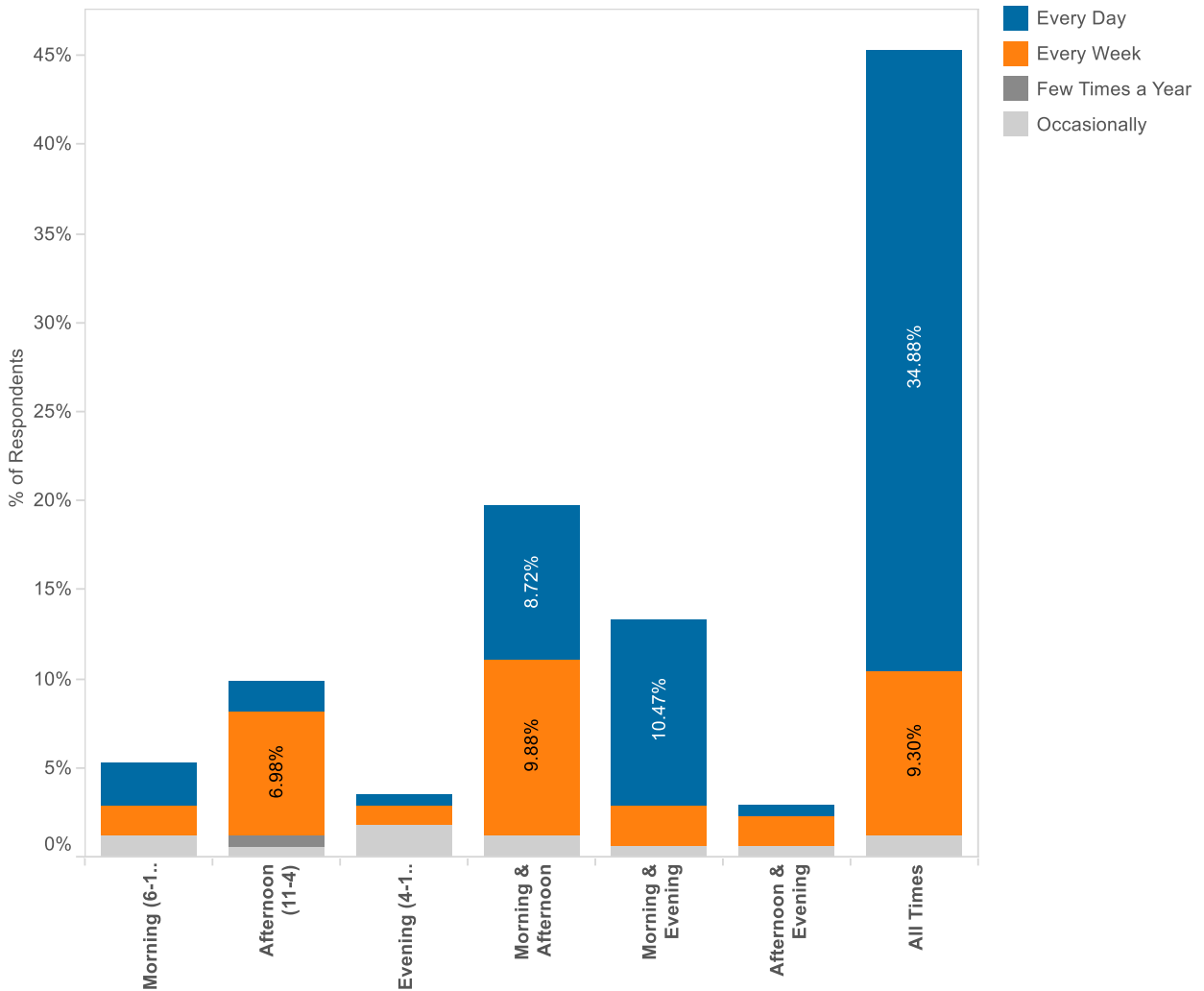


Figure 20: Time of use and frequency of rides. On the x-axis is the time of day riders reported using the bus, and each color indicates the reported frequency of utilization. (Questions 3 and 4 from survey, n=180).

## 4.2.2 Frequency of use

Next, we examined the data on respondent age to describe how ridership patterns differ for different age groups (Figure 21). The majority of people riding the bus every day were in the 25-45 and the 45-65 age groups.

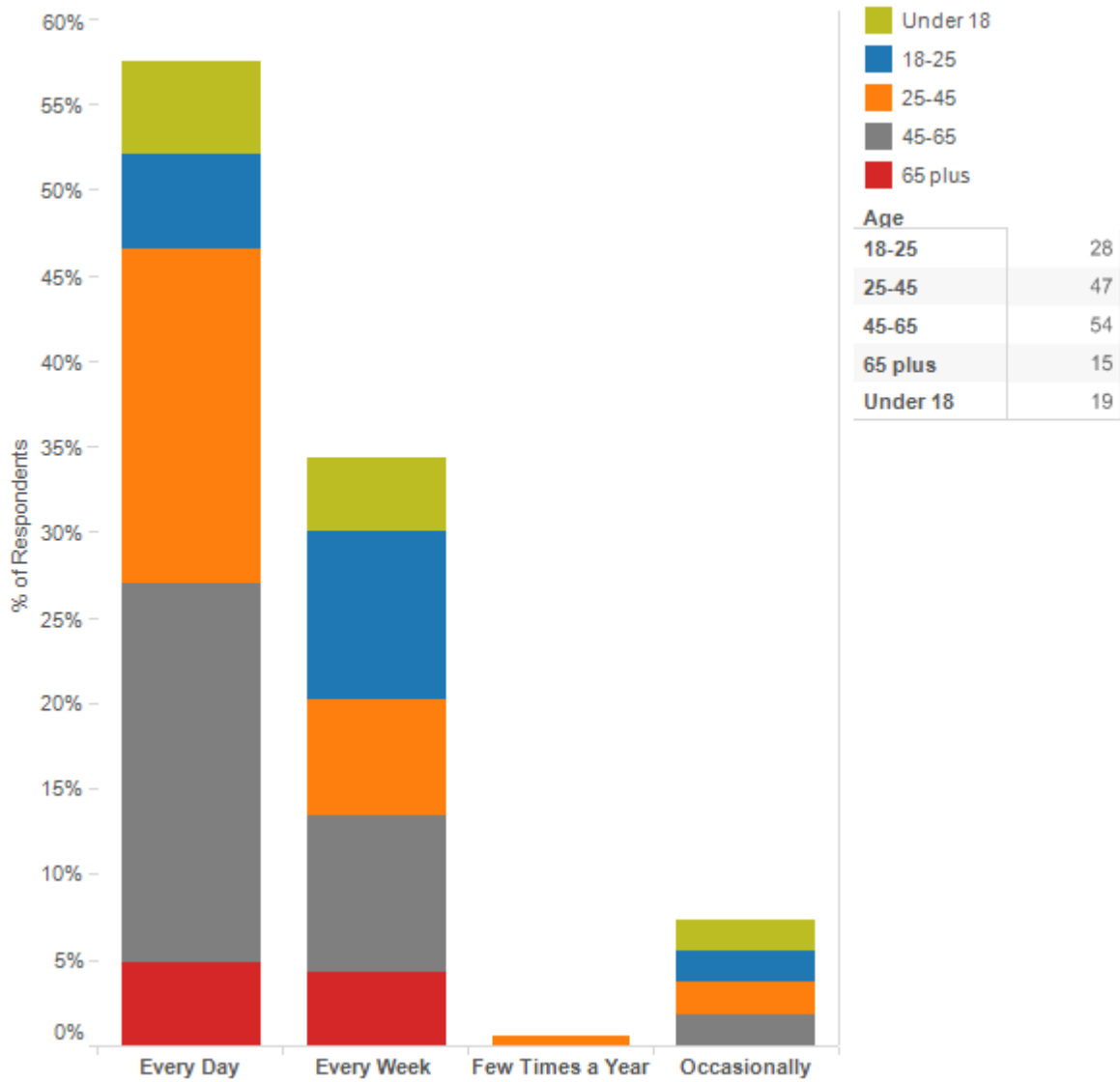


Figure 21: Frequency of Use by Age Group and table number of respondents by age group, n=180



### 4.2.3 First and last mile

To determine if there is a need for a feeder system, we asked riders how long they travel to their originating stop and from their final stop to their destination. We can see from Figure 22 that the majority of passengers travel fewer than 5 minutes to the nearest bus stop from home. However, almost as many passengers traveled between 5-15 minutes. In contrast, a majority of respondents travel over 15 minutes from their disembarking bus stop to their final destination.

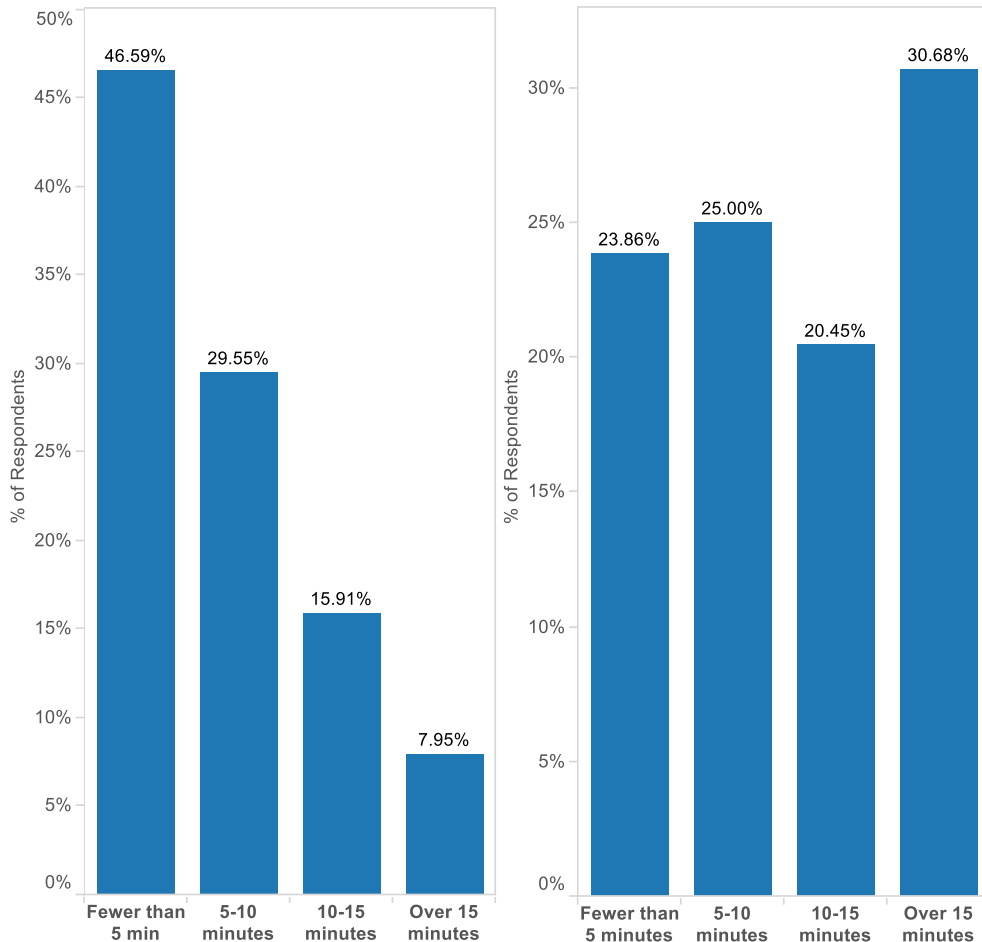


Figure 22: Commute time outside of bus system, the graph on the left shows responses to how long respondents traveled to originating stop. On the right are responses to how long travel was from their final stop to their destination, n=180

### 4.2.4 Purpose of Travel

To see what kind of passengers are riding the bus and which services would be the most useful for these passengers, we asked riders why they chose to ride the bus. Including

only options that received at least 3 responses Figure 23 below shows the reasons riders commuted on the bus, the “blank” column indicates surveys that left that question unanswered. Not surprisingly, most riders commuted to home since however it is important to note that the majority of riders commuted only to school with Work/Shopping/Home a close second.

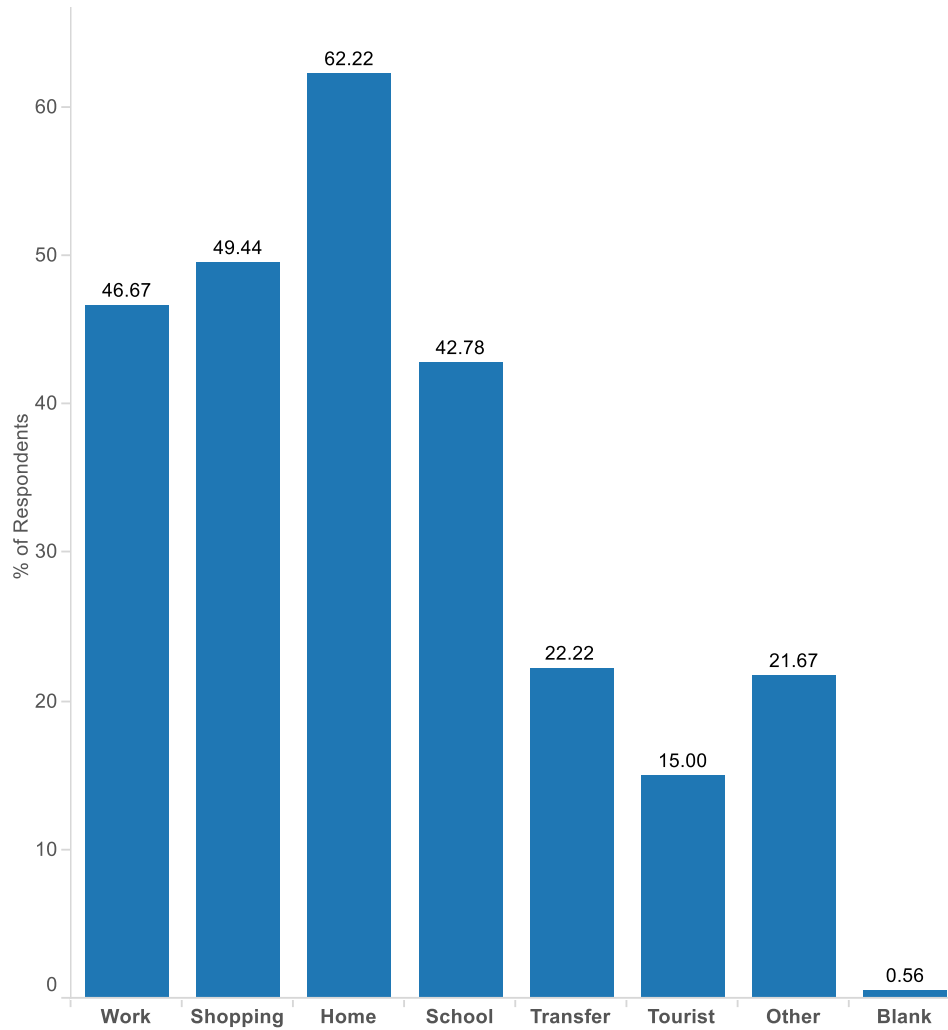


Figure 23: Purpose of Commute, each column is independent of the others, i.e. columns don't add to 100%

### 4.2.5 Satisfaction

Finally, the overall satisfaction of riders was measured in order to identify if there was a connection between utilization and satisfaction. In other words, the service provided is hindering people from riding the bus. Figure 24 displays how riders rated the Santa Fe

Trails system overall. Riders found the system to be satisfactory, as 76.41% rated it as “good” or “great” with only 3.37% reporting the system was “bad”.

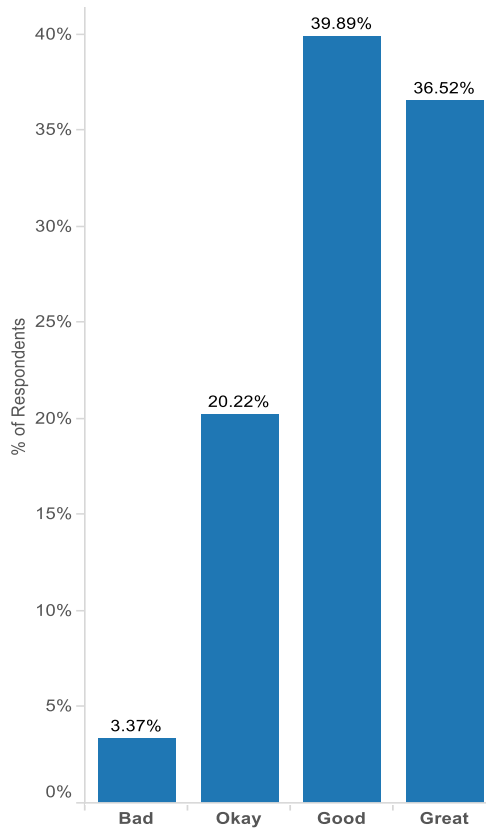


Figure 24: Rider Satisfaction

#### 4.2.6 Rider Comments

Figure 25 shows a word cloud of respondent comments from the surveys. We removed the terms bus and buses since those are intrinsically common in most comments.

We received a great deal of feedback on the southern routes. Currently, the Santa Fe Community College has no bus service on weekends. Additionally, many riders responded wanting expanded weekend service on multiple route.



Figure 25: Word Cloud of Rider Comments

## 4.2.7 Observations & Interactions

### Route 2 Ridership Patterns

We used real-time observations of riders using route 2 in order to gain insight into ridership patterns on this route in advance of pilot-testing an express bus. From the four days of observations, which included the 7-9 morning peak and the 4:30-6:30 evening peak time, we compiled trip data for all the passengers whose embarkation and debarkation data we recorded. Below, Figure 26 show these data mapped as “hops”. In the plot, the darker areas, or where the most lines intersect, represent the “hot spots” or the areas where most passengers traveled to or from. Refer to Appendix H: Enlarged Passenger Trip Data for an enlarged view.

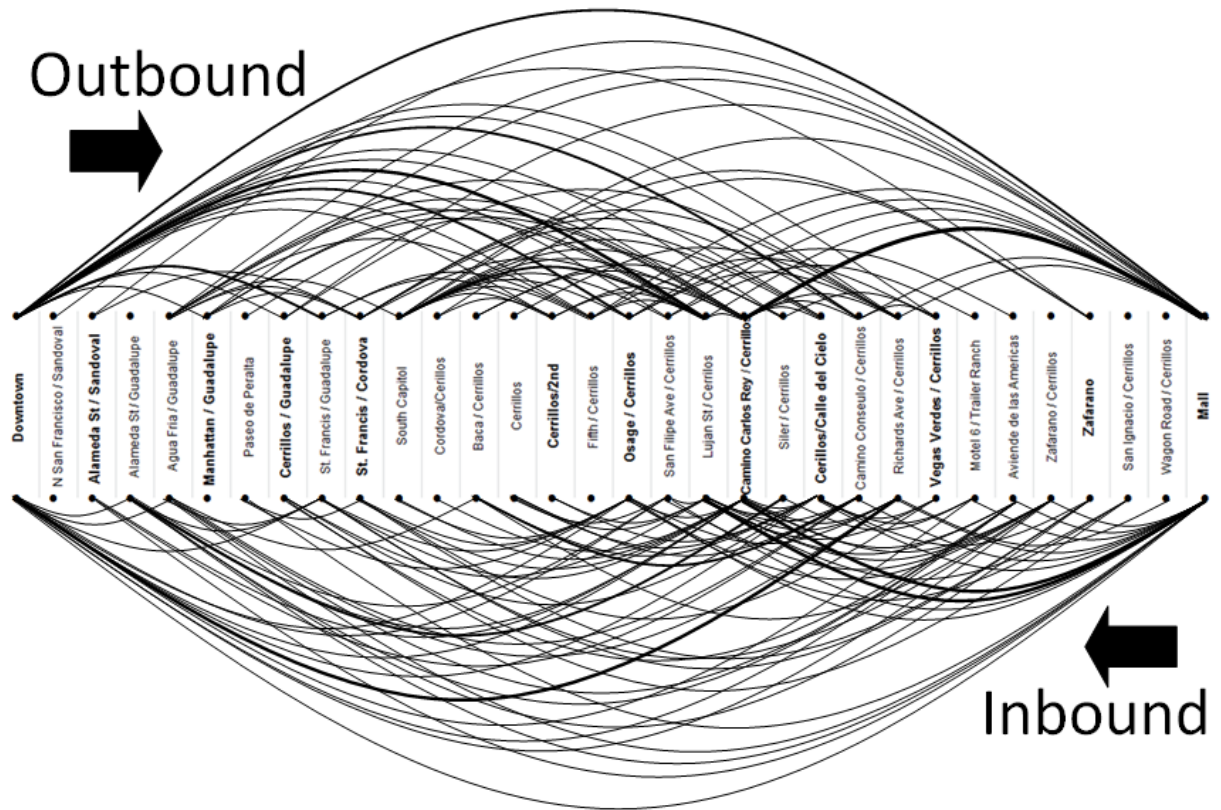


Figure 26: Passenger Trip Data The top lines represent outbound trips and the bottom inbounds trips, line thicknesses represent the number of people that took that trip. A total of 123 inbound and 104 outbound trips are represented.

### M line & Santa Fe Pickup

We rode the M line for a total of 3 cycles. The M line of the Santa Fe Trails connects Museum Hill, St. John’s College, downtown, and the Santa Fe commuter rail station (Figure 27). During the two days that we rode the M line (4/15 & 4/17), we recorded 7 passengers. Five were going to Museum Hill, with one passenger going to St. John’s and another to downtown. The passengers who went to Museum Hill were tourist while the others were local residents.

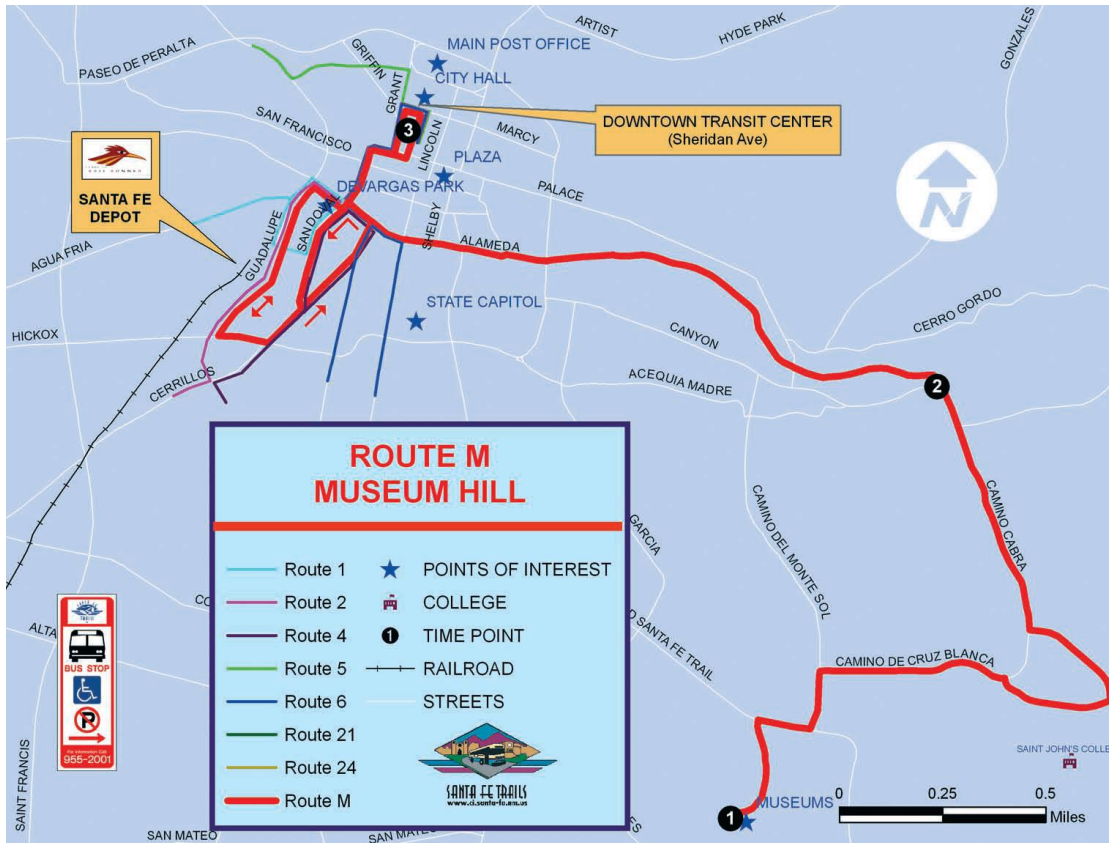


Figure 27: M line route

While the M line was relatively empty, the Santa Fe Pickup was very full. The Santa Fe Pickup operates a maximum of 4 buses at a time on a fixed circuit. At peak hours, when the train comes into the Santa Fe Depot, all 4 buses line up to pick up train passengers. All buses are filled with train passengers, and the bus we rode made two trips to the depot when the train came in. Both times we picked up 20 riders, which filled up the bus. Of the 40 passengers who rode on those two trips, most passengers (30) went to the plaza, 6 went to La Fonda hotel, and the rest went to the state capitol building.

# 4.3 Analyzing System Improvements by Resource Redistribution

Based on the data that we collected, we explored new services that can be implemented by utilizing existing resources. A model feeder system that could be implemented in Santa Fe was explored, and the data from an express Route 2 bus running during peak was collected during a pilot test.

## 4.3.1 Feeder System

To analyze the possible feeder system for SFT, we gathered data about the Fort Marcy shuttle, which provided us with details about 10 days of use by hotel guests. There were a total of 26 trips taken in that period, with the Fort Marcy Office being the origin or destination of all trips as seen from the data set. This parameter was important as the feeder system pilot would most likely use one bus stop as the origin or destination hub to passengers. The passenger data was collected from April 8<sup>th</sup> – 18<sup>th</sup>. The shuttle runs from 8 am – 4 pm during the weekdays and results from the trips during that time period are listed below.

When riders call to reserve the shuttle, there is a little wait time before they are picked up. These times are listed below in Figure 28 where wait times are listed in 5 min increments. The median wait was found to be 8 minutes. From asking the driver during usage of the van, it was determined that the wait time is dependent on how busy the driver is with other tasks or if the shuttle is currently on another trip. In most of the cases, different trips did not conflict with each other so the wait time was assumed to be attributed to the driver being busy with other tasks. Table 4 shows the standard deviation, median and average wait times for all trips, trips originating from Fort Marcy, and trips ending at Fort Marcy. It is no surprise that trips to Fort Marcy have higher wait times as Fort Marcy Shuttle is situated at the Fort Marcy Office.

Table 4: Statistics on Wait Time for Fort Marcy Shuttle

	All Wait Times	From FM	To FM
<b>Standard Deviation</b>	5.57	7.77	6.43
<b>Median</b>	8.00	3.00	7.50
<b>Average</b>	8.65	6.60	8.50

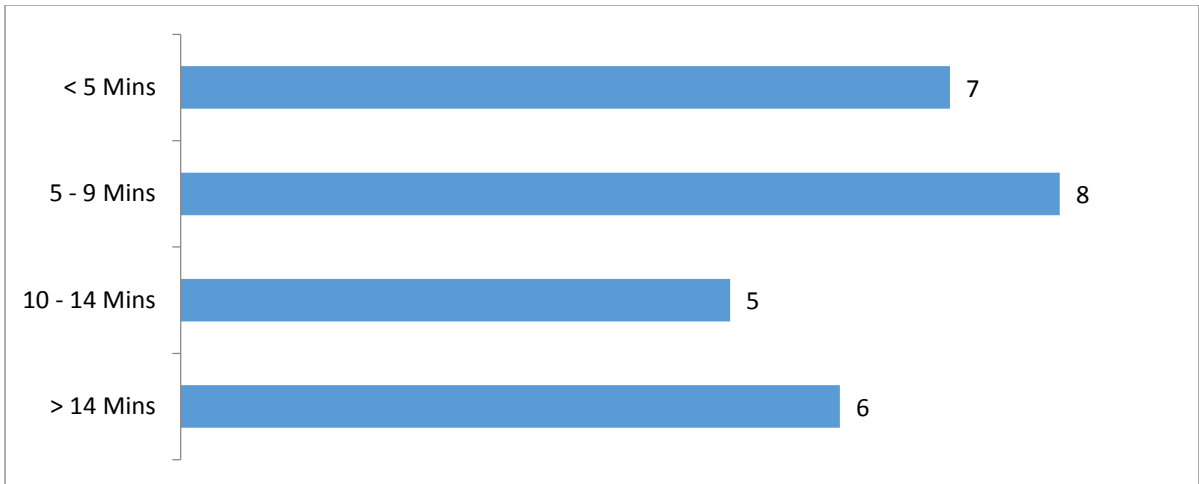


Figure 28: Shuttle Wait Times after Call and Before Pick Up

The Fort Marcy shuttle can be utilized from morning to early evening. In the 10-day period, the earliest time the shuttle was called was at 9:00 AM and the latest being 3:50 PM. The Figure 29 shows the time of day during which shuttle trips were taken. The trips are spread out throughout the day with slightly less trips during the morning hours. This is understandable as most of the residents of Fort Marcy are tourists or stay for short term.

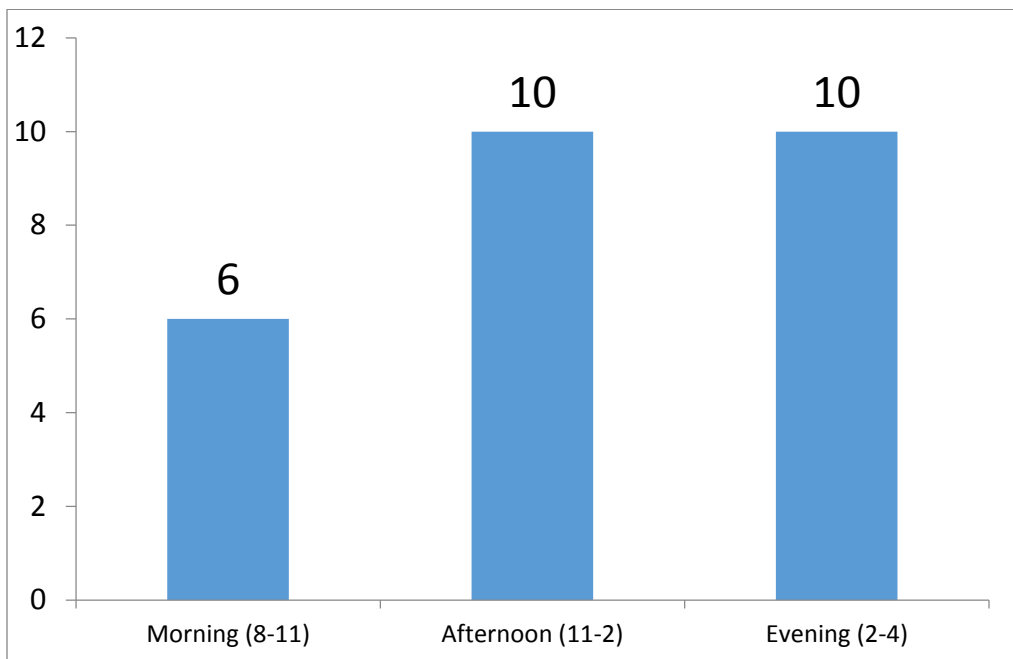


Figure 29: Shuttle Call during Time-of-Day



The travel time for various trips is shown before in Figure 30. This trip time only includes the time when the passengers are picked up and when they are dropped off at their destination. However, this time is logged by the concierge who is fed information by the driver upon drivers' return. Most of the trips took 5 – 15 minutes with the average trip time being 9 minutes and 42 seconds with standard deviation is 6.48 and median being 9 minutes.

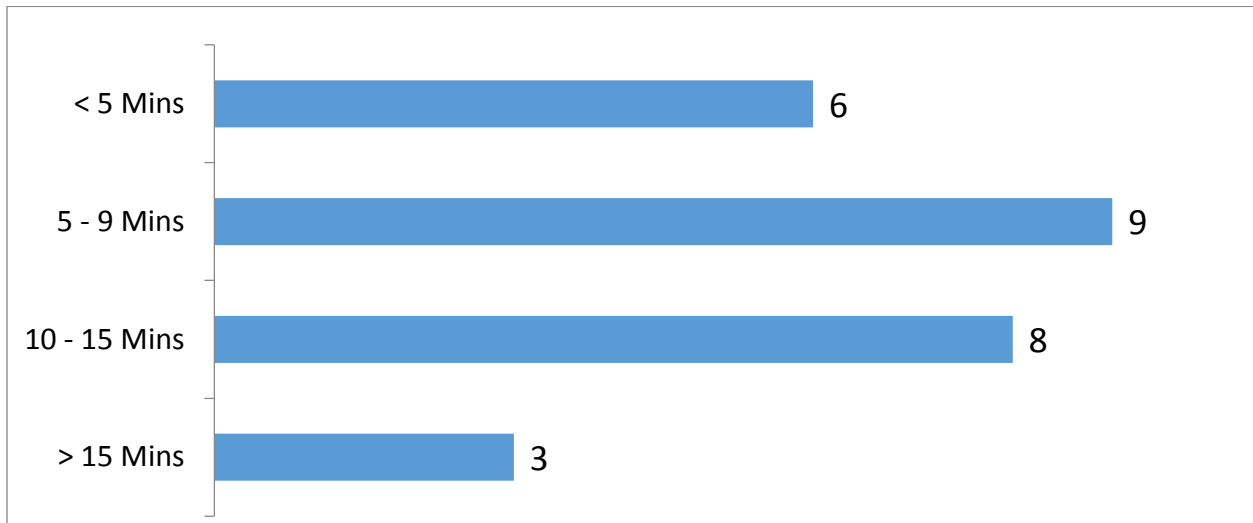


Figure 30: Travel time for shuttle trips

The Call-n-Ride from Denver is an example of functioning feeder system in the US. Examples from the Denver system were taken in order to get an estimate for how many vans are needed for an operational area. Population per operational area is also a good starting point for recommending a pilot test area in Santa Fe. Population per operational area is listed in Background section 2.3.2 in Table 2.

Denver Call-n-Ride operates in a fixed area, with the largest area being 11 square miles within which all trips take place. Figure 31 shows the numbers of peak hour vans that operate in the various coverage areas of the Call-n-Ride, along with the number of passengers served per year in the area. The coverage area is listed in square miles with the number of vans that operate in that area shown on top of the coverage area in orange. Most areas have only 1 van that serves that area with few exceptions which is explained below.

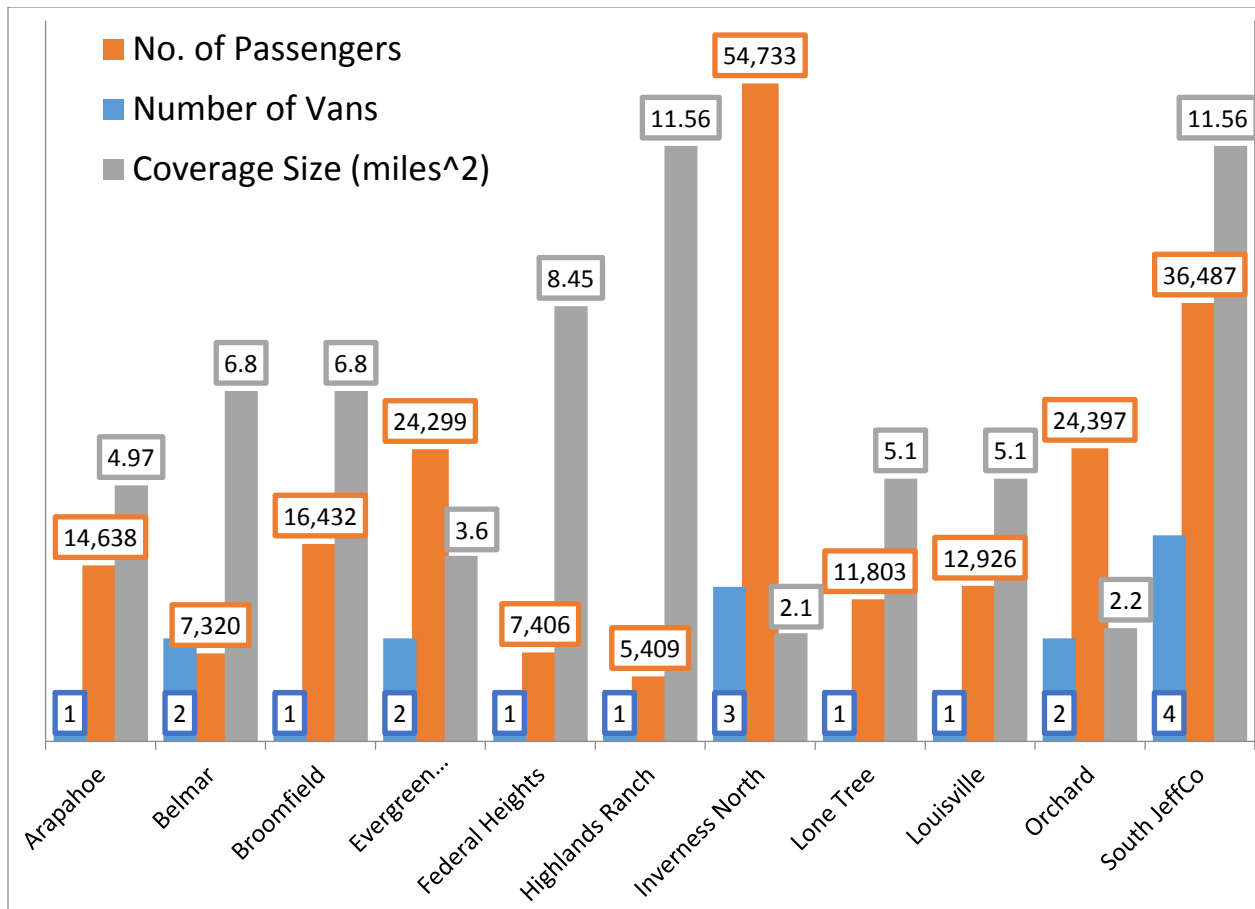


Figure 31: Number of Peak Hour Vans (Blue) operating in the given Coverage Area (Grey) along with passengers in the coverage area (Orange)

The population in a given area is not always reflective of the number of passengers served in that area. Table 2 shows the population estimates located in the areas that are served by Call-n-Ride service. The number of passengers served by Call-n-Ride in the year 2013 is shown in Figure 31. With the exception of Belmar, most of the areas with fewer than 20,000 passengers have 1 van and areas with more than 20,000 passengers have 2 or more vans. The largest number of peak hour vans is found in South Jefferson, with 4 vans. Sometimes the number of passengers served Call-n-Ride in an area is larger than the population of that area, for example Inverness North listed in Table 2 and Figure 31. That occurs when there is a light-rail station or another public transport service that inflates the number of passengers traveling through or working in that area. The data on the Denver Call-n-Ride is provided by Brian Matthews, RTD manager of Denver service area.

### 4.3.2 Route 2 Express Bus

We used our data from Route 2 observations (Figure 26) to identify stops that had the most use. We chose 12 stops to be part of the Express Route pilot test based on the parameters we described in Section 3.3.2. The stops are shown in Table 5.

Table 5: Chosen Express Route Stops along with Santa Fe Trails' internal stop numbers.

Stop Names	SFT Internal Stop #'s	
	Outbound	Inbound
Downtown Transit Center	94001	94001
The Hilton	94003	94085
Santa Fe Depot	96036	96067
Cerrillos and Guadalupe	94165	2065
Cordova and St. Francis	94090	94126
Cerrillos and Second Street	94094	94121
Cerrillos and Osage	94096	94118
Camino Carlos Rey	2069	94117
Calle de Cielo	94101	94114
Vegas Verdes	94105	3003
Zafarano Street	97057	3002
Santa Fe Place Mall	96029	96029

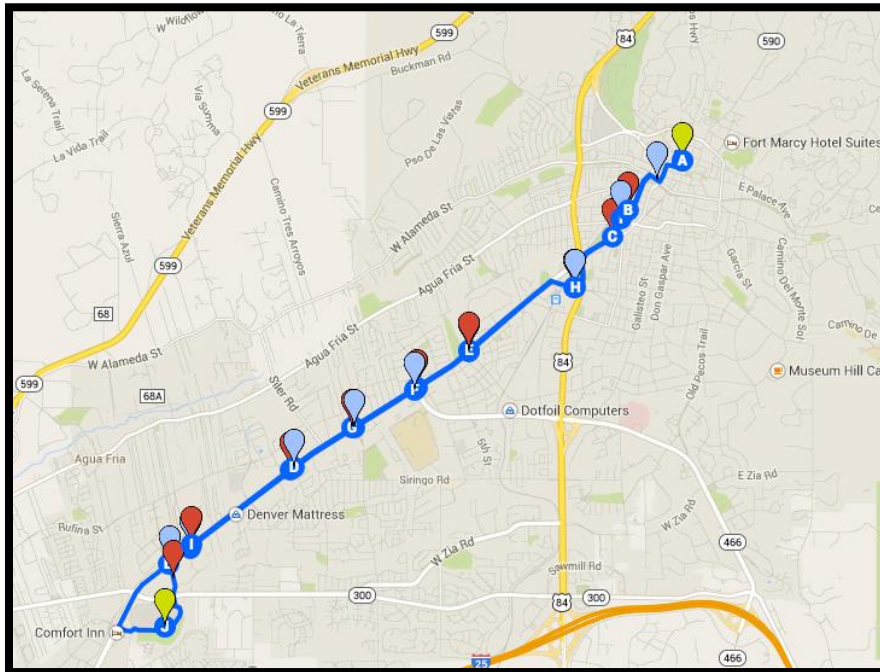


Figure 32: Express Bus Route with Stops (Blue-Outbound, Red-Inbound, Green-Both)

The intent of the pilot test was to gather useful feedback from riders, so to ensure we had a reasonable number of riders, we needed to advertise the pilot test. To that end, we designed informative signs and had them placed in each Route 2 bus for 5 days before the pilot test began. These signs included information such as the start and end dates and times of the test and what stops were going to be included.

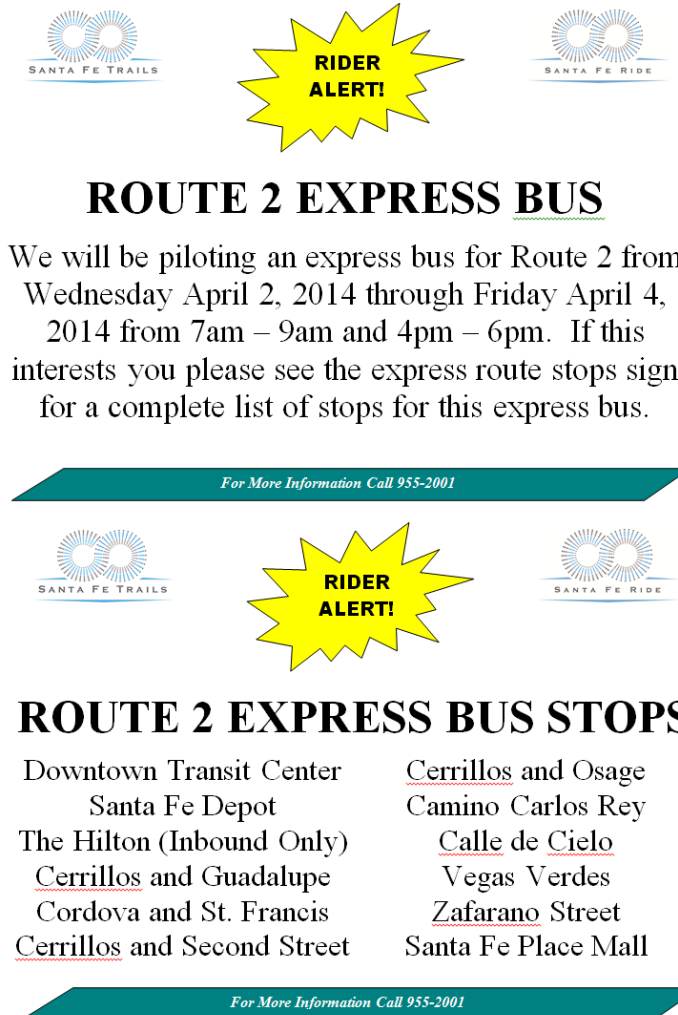


Figure 33: Express Pilot Alert Signs

We had a total of 37 riders during the pilot test. We had 21 at total at morning peak and 16 during evening peak. However, we only received 23 survey responses.

Our survey of pilot test users asked them to provide an overall rating for the service, and all respondents rated the service as “average” or above compared to the normal bus service, with almost 80% rating it as “excellent” (Figure 34).

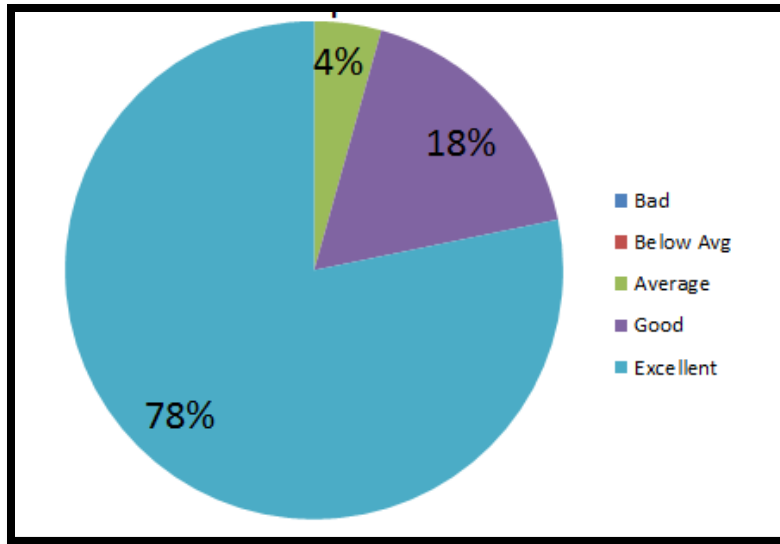


Figure 34: Express Bus Service Rating

Over 24 total runs of our pilot bus, the total time ranged from 21-30 minutes, with a median time of 25 minutes. We have noted that the regular bus takes around 35-50 minutes to complete its total route that can include any of the 34 stops on Route 2. However, we did not track the exact trip durations of the regular bus. A more in-depth study would need to be done in order to have a concrete comparison of the difference in times.

## 5. Analysis & Recommendations

After collecting all of the results from our project, we analyzed them and formulated recommendations. Overall, Santa Fe Trails has steadily increased ridership in the past ten years. However, we believe that implementing our recommendations would further improve Santa Fe Trails' service and utilization.

### 5.1 Improve Rider Information

Based on our results from the surveys and interactions with riders, overall the information presented at the new bus stop shelters is easy to read for people who regularly ride the bus and have used the system for a while. However, many tourists may have a hard time understanding the system and interpreting this information. We recommend placing "you are here" stickers at each of the bus stop signs so that new riders can at least see where they are in relation to the system. We also talked to many smartphone users that were excited by the idea of an app that could give them current bus stop information and locations. Many people that currently use their phones to access bus information reported that they are often looking for changes such as holiday hours or other transit schedules. We recommend having this information in one place on the app so that accessing the information would be easier for riders. When we asked riders about SMS texting, only a slight majority said that they would use this system. However, from looking at other systems that do use SMS texting, we found that a lot of people find it useful even if they have a smartphone. Another factor to consider is the number of calls that Santa Fe Trails receives regarding bus information. A text message service could alleviate a lot of phone traffic that the dispatcher has to deal with. Overall, we would recommend a SMS texting system to add another way for riders to obtain bus information quickly.

### 5.2 Design a Feeder System Pilot

The results from our surveys and observations on the bus showed that a vast percent of commuters have to travel more than 10 minutes to reach a bus stop. . It is important to note that trip times from bus stops to destination are much longer than trip time from origin to a bus stop Figure 22 shows that 24% of people have to walk 10 or more

minutes to get to a bus stop and 51% have to walk the same amount of time from bus stop to destination. There is not enough data to determine in which area majority of the population have to walk more than 10 minutes from a bus stop. While there are other options available as mentioned in section 2.3.2, we propose to have taxi like feeder system that commuters can use to and from bus stops. Such a system would work for both passengers traveling to a bus stop as well as from a bus stop. One such system we studied was the Denver Call-n-Ride. It is a feeder system that is located in 23 neighborhoods in and around Denver that range from 12 miles<sup>2</sup> to 3 miles<sup>2</sup> radius. The system served 489,161 passengers in 2013 and operated for some 100,000 hours. Before implementing such a system, we recommend running a pilot test in Santa Fe. Below, we describe some guidelines and recommended locations for such a test.

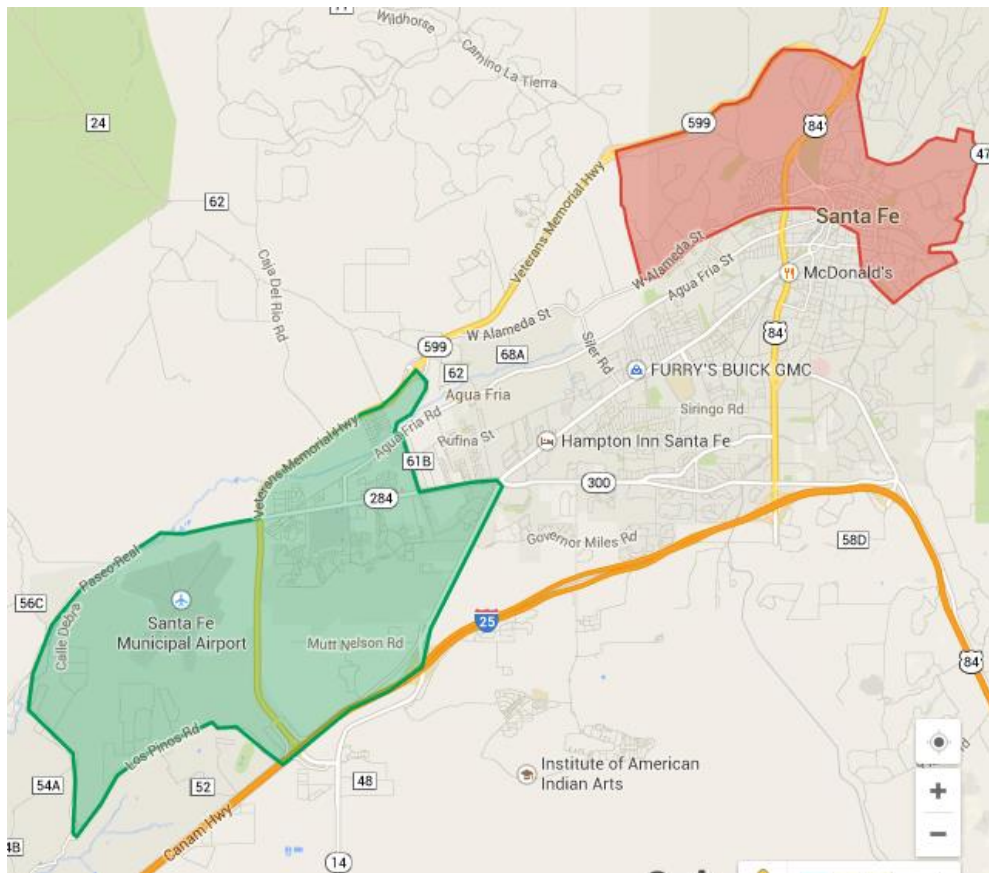


Figure 35: Feeder System Proposed Area for pilot testing (Red Area pop. – 13228)(Green Area pop. – 13120)

With population to passengers per year ratio of 2:1, Denver provides on average 1 van per 10,000 population or 5,000 passengers per year. Most areas have more than 1 van during peak service hours. Figure 35 shows our two recommended area of Santa Fe for

feeder system as determined in Section 4.3.1 but with a combined third area in the north. The northern area has a population 13,228 and southern area has a population of 13,120. As the areas have a population around 10,000, our 1 van recommendation is based on Denver's example. There should also be 1 extra van ready on stand-by to be utilized during busy hours. Vans should operate during fixed bus hours and not on weekends to ensure the service is utilized by commuters and not for unnecessary purposes. As for the stations for vans, we recommend placing them at a bus stop near the center of the coverage area. These areas were chosen because they are not covered by any fixed route bus lines and have a relatively low yearly income as well as dense population as shown in Figure 13. We again made the assumption that people of lower economic background use the public transportation more often than population from the higher end of that spectrum. As for finding the exact bus stops from where long travel times occur, we recommend creating a survey specifically geared towards finding out this information. Our surveys did not cover information on where long travel times occurred but uncovered that there are numerous instances of long travel times.

Another location we are recommending as a feeder pilot test location is the same northeast section of Santa Fe proposed by 2013 WPI bus team shown in Figure 10. This area has been combined with our recommended area in the north (shown in Figure 13) is the Red area in Figure 35 This area is currently covered by M line fixed bus route, which has been targeted by the city to cease operations at the end of this year. As a result, adding a feeder shuttle to this area can assist tourists traveling to Museum Hill. One van will be situated at or near down town plaza to pick up people wishing to travel to Museum hill. This van will only leave the plaza if there is a call for service nearby. The second van in this area will be situated near the Museum hill, mirroring the service of the previous van. These locations will make it easier for tourists to find the feeder service. These vans can be replaced by one of the four vans from Santa Fe Pick Up. It is possible for the Pickup that sits idly to cover the northern proposed area of the feeder.

It will be up to future studies to determine specific details of where and how to execute the pilot test. From Fort Marcy data, we determined that wait time for customers can be around 10 minutes for a 3 square mile area. In addition, no more than 30 minutes of round trip time was given to one customer. It is important to note that Fort Marcy Shuttle differs from a public transit feeder pilot test in several key ways. First, the Fort Marcy Shuttle only serves it residents who are mostly tourists. This varies their destination from



commuters. In addition, the location of Fort Marcy differs from feeder pilot test locations, which could cause a few minute differences in travel times. Thus, feeder pilot tests should not use Fort Marcy data as guidelines to running their tests, but as a data set that can be carefully used in their planning.

### 5.3 Create an Express Line on Route 2

Based on the responses that we received during our pilot test of an express bus on Route 2, we concluded that it would be beneficial to Santa Fe Trails to offer this service to riders in the future. In our interactions with the people on the van, we noted that the majority of riders expressed a desire to see this service incorporated into Route 2. We also noted that the riders seemed pleased with how much faster the service could get them to their destination.

We believe the Express Bus would work best being run how we piloted it. It would start every weekday morning at 7 am from Santa Fe Place Mall and complete two round trips at 30 minutes each, finishing at 9 am. Then in the evening it would begin at 4 pm at the Downtown Transit Center and also make two round trips, finishing at 6 pm. The full schedule with express times added can be seen in Appendix K.

Route 2 Express - Downtown - Cerrillos - Santa Fe Place								
Weekday Outbound					Weekday Inbound			
	Downtown Transit Center <b>7</b>	Santa Fe Depot <b>6</b>	Cerrillos & Osage <b>3</b>	Santa Fe Place <b>1</b>	Santa Fe Place <b>1</b>	Cerrillos & Osage <b>3</b>	Santa Fe Depot <b>6</b>	Downtown Transit Center <b>7</b>
AM	-	-	-	-	7:00 AM	7:03 AM	7:14 AM	7:28 AM
	7:30 AM	7:43 AM	7:55 AM	7:58 AM	8:00 AM	8:03 AM	8:14 AM	8:28 AM
	8:30 AM	8:43 AM	8:55 AM	8:58 AM	-	-	-	-
PM	4:30 PM	4:33 PM	4:45 PM	4:58 PM	5:00 PM	5:13 PM	5:24 PM	5:28 PM
	5:30 PM	5:33 PM	5:45 PM	5:58 PM	6:00 PM	6:13 PM	6:24 PM	6:28 PM

Figure 36: Proposed Schedule for Express Bus with Time Points

We considered two different options that we think would work best for Santa Fe Trails in order to accomplish this.

### ***Option 1***

The first option is for Santa Fe Trails to use an additional bus for the Express Line. The benefits of this would be that the regular Route 2 bus would continue to run every 15 minutes and adding another bus would reduce crowding to the rest of the Route 2 lines. However, it would also cost Santa Fe Trails more money to run an extra bus. While the vehicle would be repurposed from somewhere else, such as the M line or the Santa Fe Pick-up, or would use a smaller van that is not currently being used, there would still be costs to run the vehicle and to pay another driver. Santa Fe Trails has estimated the cost per hour as \$54.71. This covers cost of the driver and fuel. They also estimate that the cost per mile is \$1.32. This cost covers vehicle maintenance and repairs. Using this data, combined with the number of hours and miles the express bus would be running every day, we calculated that if another vehicle were to be added, the addition running costs of the express line would be \$74,973 per year. Our cost estimate is based on average hourly and per-mile cost for Santa Fe Trails' operations, and is therefore subject to error in this application. We recommend that more detailed estimates of cost be carried out prior to the implementation of an express route.

### ***Option 2***

The second option is to use one of the existing 6 buses on Route 2 as the express bus. The advantage of this is that it would not create any additional costs for Santa Fe Trails, or take up any additional vehicles. The disadvantage of this is that the buses would no longer come every 15 minutes. As the express bus neared its destination, there would be about 20 minutes between it and the bus after it. However, the differences can be noted on the schedule to make that clear to the riders (Figure 37).

ROUTE 2 - DOWNTOWN - GUADALUPE - CERRILLOS - SANTA FE PLACE							ROUTE 2 - DOWNTOWN - GUADALUPE - CERRILLOS - SANTA FE PLACE						
WEEKDAY OUTBOUND							WEEKDAY INBOUND						
Downtown Transit Center 7	Santa Fe Depot 6	Saint Francis / Cordova 5	South Capitol Station 4	Cerrillos & Osage 3	Cerrillos & Siler 2	Santa Fe Place 1	Santa Fe Place 1	Cerrillos & Siler 2	Cerrillos & Osage 3	South Capitol Station 4	Saint Francis / Cordova 5	Santa Fe Depot 6	Downtown Transit Center 7
Bold times indicate Express Bus							5:30a	5:41a	5:45a		6:01a	6:09a	6:13a
							6:12a	6:21a	6:25a		6:29a	6:37a	6:41a
							6:24a	6:36a	6:40a		6:44a	6:52a	6:56a
							6:39a	6:51a	6:55a		7:01a	7:09a	7:13a
							<b>7:00a</b>		<b>7:03a</b>			<b>7:14a</b>	<b>7:28a</b>
6:28a	6:32a	6:40a		6:47a	6:51a	7:03a	7:09a	7:21a	7:25a		7:29a	7:37a	7:41a
6:50a	6:54a	7:02a		7:07a	7:11a	7:23a	7:29a	7:41a	7:45a		7:49a	7:57a	8:01a
7:12a	7:16a	7:24a		7:29a	7:33a	7:45a	7:50a	8:02a	8:06a		8:10a	8:18a	8:22a
							<b>8:00a</b>		<b>8:03a</b>			<b>8:14a</b>	<b>8:28a</b>
<b>8:30a</b>		<b>8:43a</b>	<b>Rail Runner Insert</b>		<b>8:55a</b>	<b>8:58a</b>	8:20a	8:32a	8:36a		8:40a	8:48a	8:52a
7:42a	7:46a	7:54a		7:59a	8:03a	8:15a	8:35a	8:47a	8:51a		8:55a	9:03a	9:07a
7:57a	8:01a	8:09a		8:14a	8:18a	8:30a	8:50a	9:02a	9:06a		9:10a	9:18a	9:22a
8:12a	8:16a	8:24a		8:29a	8:33a	8:45a	9:05a	9:17a	9:21a		9:25a	9:33a	9:37a
<b>8:30a</b>		<b>8:43a</b>	<b>Rail Runner Insert</b>		<b>8:55a</b>	<b>8:58a</b>	9:20a	9:32a	9:36a		9:40a	9:48a	9:52a
8:42a	8:46a	8:54a		9:01a	9:05a	9:17a	9:35a	9:47a	9:51a		9:55a	10:03a	10:07a
4:12p	4:16p	4:24p		4:29p	4:33p	4:45p	<b>5:00p</b>		<b>5:13p</b>			<b>5:24p</b>	<b>5:28p</b>
<b>4:30p</b>		<b>4:33p</b>	<b>Rail Runner Insert</b>		<b>4:45p</b>	<b>4:58p</b>	5:18p	5:30p	5:34p		5:38p	5:46p	5:50p
4:42p	4:46p	4:54p		4:59p	5:03p	5:15p	5:33p	5:45p	5:49p		5:58p	6:06p	6:10p
4:57p	5:01p	5:09p		5:14p	5:18p	5:30p	-	-	-		-	-	-
5:12p	5:16p	5:24p		5:29p	5:33p	5:45p	<b>6:00p</b>		<b>6:13p</b>			<b>6:24p</b>	<b>6:28p</b>
<b>5:30p</b>		<b>5:33p</b>	<b>Rail Runner Insert</b>		<b>5:45p</b>	<b>5:58p</b>	-	-	-		-	-	-

Figure 37: Proposed Schedule for Express Bus with No Additional Vehicles

## 5.4 Determine the Feasibility of a Santa Fe College Shuttle

Through our surveys, casual conversations with riders, and discussion with our liaison, we learned that there is quite a bit of interest in creating a way for college students to get around. As seen on the route map in Appendix G, lines 21, 22, and M all have colleges on their routes. These lines are very spread out and it can take over an hour to get from one to the other or to downtown based on scheduled times. If a connection is missed, the trip will take much longer due to the infrequency of those routes. Our sponsors informed us that the recently elected mayor of Santa Fe is interested in having a service that would connect together all the colleges with Downtown Santa Fe. The data that we collected through our surveys and informal discussions with riders showed that there is a need to

have a way to get to the colleges on weekends. With the surveys, 16 out of 181 respondents, when asked what they would change about the system, stated that they would like longer night and weekend service to the colleges. Three people also specifically said that they would like a route that would go from Downtown straight to Santa Fe Community College.

### ***Proposed Route***

Our sponsors were interested in the idea of running a shuttle-like system similar to the *Santa Fe Pick-Up* that would go between these places so students can get around more easily. We identified the optimal route that would connect all of the local colleges with one another, and we also identified locations that we thought may be of interest to college students. The proposed route includes all four colleges in Santa Fe: the Institute of American Indian Arts, Santa Fe Community College, Santa Fe University of Art and Design, and St. John's College. The other locations include the Santa Fe Place Mall, Santa Fe Depot, and Santa Fe Plaza in downtown. The proposed route for the shuttle would start at the Institute of American Indian Arts and terminate at St. John's College (figure 28). We estimate that the planned route would take about one hour to get from IAIA to St. John's with all stops.



Figure 38: Proposed Route for College Shuttle

**Proposed Schedule**

The college shuttle would be most beneficial if it ran during the hours that there is no bus service to SFCC and IAIA on Friday nights and weekends. This way people can get to evening or weekend classes as well as to and from campus for studying at school, or going out to the mall or downtown. The shuttle would only need to run during the times that the fixed route bus is not already running to those schools. Based on the times that the colleges do not have service, which were discussed in Section 2.2.4, we designed a schedule that would only run the shuttle when needed.

To start, we suggest that the shuttle run on Friday nights (7-11pm) doing the proposed route, Saturdays (8am-7pm) doing a condensed route that would only run between IAIA, SFCC, and the Mall, and then Saturdays (7-11pm) doing the full route once again (see Table 6 below). The condensed route is the best choice during the day as during

that time, only IAIA and SFCC do not have service. This route would still allow students to make connections to other routes at the mall without having to run this shuttle as much.

Table 6: Proposed Schedule for College Shuttle

	<b>Friday</b>	<b>Saturday Day</b>	<b>Saturday Evening</b>
<i>Route</i>	Full	Only IAIA-SFCC-Mall	Full
<i>Schedule</i>	7pm-11pm	8am-7pm	7pm-11pm
<i>Frequency (1 bus)</i>	2 hours	30 minutes	2 hours

This would make the best use of resources as the shuttle would only run during the times that the fixed route bus is not in service. Since it will take the shuttle about an hour to run one way, we believe that there should be two shuttles running in order to keep the frequency to an hour instead of the two hour frequency that one shuttle would create.

**Cost of Shuttle**

Based on the schedule that we made, we calculated the potential running costs of both having 1 shuttle (2 hour frequency) and 2 shuttles (1 hour frequency). If the 2 shuttle option was chosen, the second shuttle would only be used on Fridays and Saturday evenings when the shuttle is doing the full route from IAIA to St. John’s. The second shuttle could then be used for other tasks during the times that it is not on the college shuttle route.

Using the same cost date we used for the express shuttle in the previous section, we took the number of hours that the shuttle is scheduled to run, plus the estimated number of miles the shuttle would cover during those hours, and arrived at the estimated running costs of the shuttle for the two options we discussed (displayed in Table 7). As with the express bus, this data is an estimate of the expected cost and would need to be looked at in more detail before implementing this service.

Table 7: Calculated Running Costs of the College Shuttle Options

<b>1 Bus (2 hour frequency)</b>		<b>2 Buses (1 hour frequency)</b>	
\$1,570.29	per weekend	\$2,191.23	per weekend
\$54,960.24	School Year (35 weeks)	\$76,693.12	School Year (35 weeks)

Ideally, the colleges would all pay for a share of the shuttle cost which could be based on distance from other schools, student population, and frequency. After the shuttle

has been running for a year or two, and accurate ridership data has been collected, the costs can be adjusted to reflect the actual usage.

A shuttle that services the colleges and popular spots in Santa Fe during Friday nights and weekends would be the solution to the college students who expressed interest in having a method of public transportation that would allow them to get around Santa Fe when the fixed-route bus is not running.

## 5.5 Other Recommendations

### Route 22

Although the college shuttle would address the need for expanded weekend services to the Santa Fe area colleges as well as other destinations, there are still other changes that could be made to improve the overall system. We learned from... Currently route 22 stops at the human services department, time point 3 in Figure 39, a major deviation from the rest of its route. Route 26 and route 22 share a large part of their route, so if the HSD stop were moved to route 26 rather than 22 it would increase the frequency that 22 runs and shorten the overall trip to the SFCC which is its main rider demographic.



Figure 39: Route 22 Map



Figure 40: Route 26 map



## 6. Conclusion

These recommendations, if implemented, alongside our research could greatly benefit the Santa Fe Trails transit department's efforts to increase utilization and provide services that target rider demands. A few of our recommendations require further testing and analysis by future teams or the Santa Fe Trails in order to be fully implemented. However, this report contains a concrete blueprint on how to build those services and we hope that these improvements and new services will make the Santa Fe Trails system more accessible and utilized.

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-

# 8. Appendix

## 8.1 Appendix A: Survey

### SURVEY OF USAGE BY FIXED ROUTE BUS PASSENGERS



Route #: \_\_\_\_\_

Time of day: \_\_\_\_\_

Gender :  M  F Age:  Under 18  18-25  25-45  45-65  65+

1. What languages do you speak?

English  Spanish  Other \_\_\_\_\_

2. Is there any information that you would like to see in another language? What language?

3. How often do you use the Santa Fe Trails Bus System?

A Few Times A Year  Occasionally  Every Week  Every Day

4. What time of day do you use the bus?

Morning (6-11)  Afternoon (11-4)  Evening (4-10)

5. Why do you take the bus? (check all the apply)

Get to Work  Get to Shopping  Get Home  Other  
 Get to School  Transfer to Other Transportation  Visit Tourist Attractions \_\_\_\_\_

6. What stop did you get on at? \_\_\_\_\_

7. How did you get to the bus stop?

Walked  Drove  Biked  Other \_\_\_\_\_

8. How long did you travel to get to that bus stop?

Less than 5 minutes  5-10 minutes  10-15 minutes  Over 15 minutes

9. What stop do you normally get off at? \_\_\_\_\_

10. How long do you have to travel from that stop to your destination?

Less than 5 minutes  5-10 minutes  10-15 minutes  Over 15 minutes

11. Are the signs at the stops that you get on and off of easy to read?

Very Easy  Easy  Average  Hard  Very Hard

12. Have you ever asked the bus driver for information?

Yes  No

13. If yes, were you satisfied with your customer service?

Yes  No

14. Do you use a smartphone to access bus information?

Yes  No  I don't have a smartphone

If yes what kind of information do you look for?

15. Would you use a text message system that would tell you when the next bus is coming?

Yes  No

16. Did you know that if you buy a bike from a local bike shop you can get a free bus pass for a year?

Yes  No

17. What do you think of the price to use the bus?

Good the way it is  Too High  Too Low

18. How would you rate the Santa Fe Trails System

Great  Good  Okay  Bad  Horrible

19. If you could change one thing about the system, what would it be?

If you answered yes to biking to the bus stop please answer the following questions:

20. For what part of your trip do you ride a bike?

To the bus  To destination  Both

21. Have you ever found that there is not enough room on the bus bike racks?

Yes  
 No

## 8.2 Appendix B: Observation Form

Route: \_\_\_\_\_ Name: \_\_\_\_\_  
 Time of day: \_\_\_\_\_

Stop #	Total	Male	Female	Adult	Minor (<18)	Senior	Cash	Ticket	Free	Bicycle	Smartphone	Spanish	Off
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

Other Observations:
Asked driver questions?
Looked at the map?

## 8.3 Appendix C: Express Bus Evaluation Form



### Evaluation Form for Express Route

How would you rate this service? (1-5, 5 being the best)

1       2       3       4       5

Would you recommend the Express line?

Yes       No

Are there any stops that you think should be added?

---

Removed?

---

What stop did you get on?

---

Off?

---

---

## 8.4 Appendix F: Bus Stop Interaction Questions

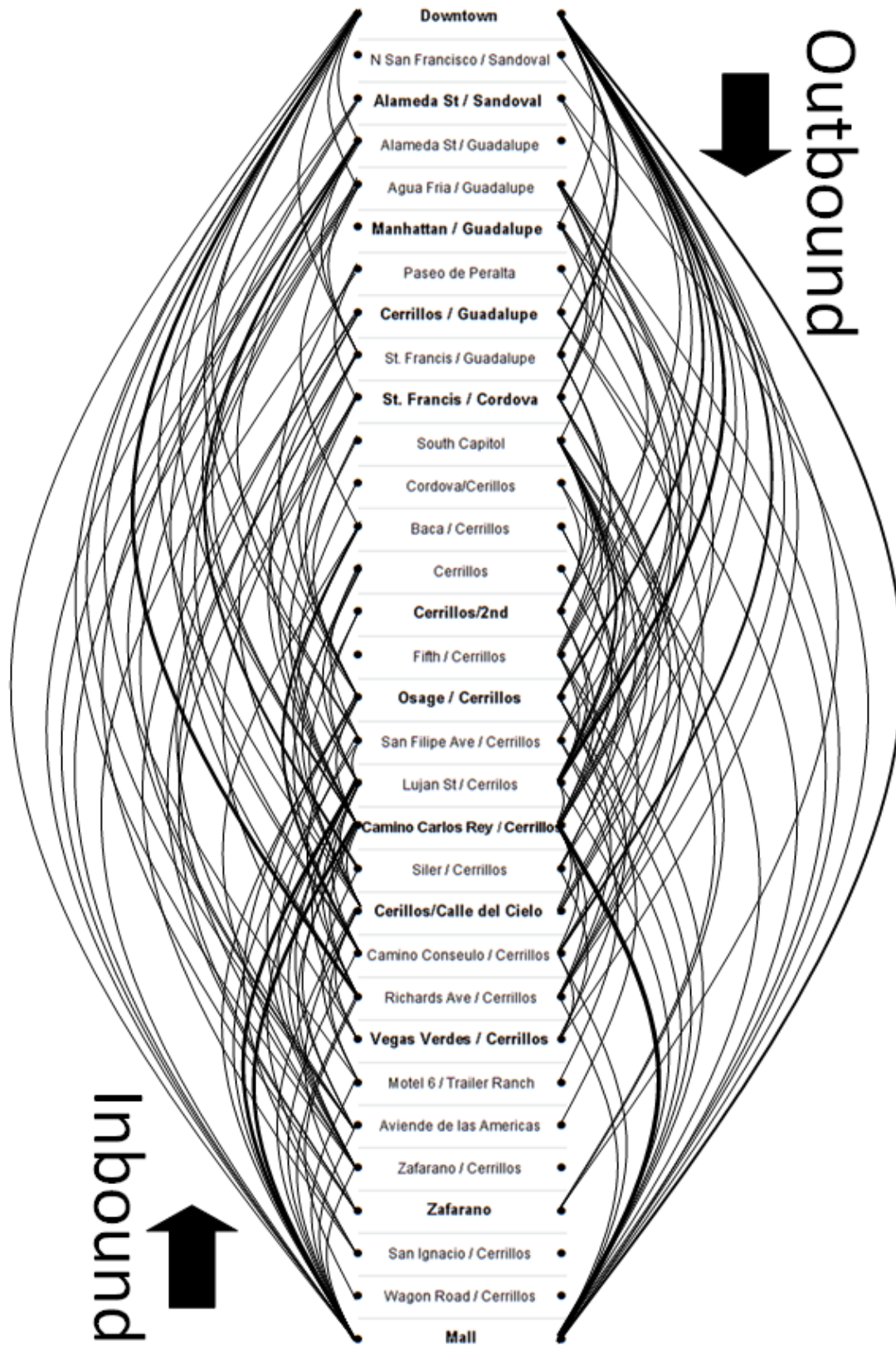
1. What route are you getting on?
2. Where are you going (What stop are you getting off at)?
3. How often do you use the bus?
  - a. Every Day
  - b. Some days a week
  - c. Rarely
4. Are the signs/information clear/easy to interpret?
  - a. Would "you are here" information be useful?
5. Technology?
  - a. Smartphone app
  - b. Google maps--trip planning
6. Do you find the overall system satisfactory?
  - a. Does it meet your demands?
  - b. Anything you would change?
  - c. Other Feedback



# 8.5 Appendix G: Fixed-Route System Map



## 8.6 Appendix H: Enlarged Passenger Trip Data



# 8.7 Appendix I: Field Work Calendar

## 2014 MARCH

CALENDAR YEAR / MONTH

SUNDAY  
FIRST DAY OF WEEK

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
16 <b>Arrived in Santa Fe</b>	17	18 <b>Kick-off Meeting with Sponsor</b>	19	20	21	22
23	24 <b>Route 2 Observations 7-9am &amp; 4-6pm</b>	25 <b>Route 2 Observations 7-9am &amp; 4-6pm</b>	26 <b>Route 2 Observations 7-9am &amp; 4-6pm</b>	27 <b>Surveys Distributed All Day</b>	28 <b>Surveys Distributed All Day</b>	29 <b>Surveys Distributed All Day</b>
30	31	01	02	03	04	05

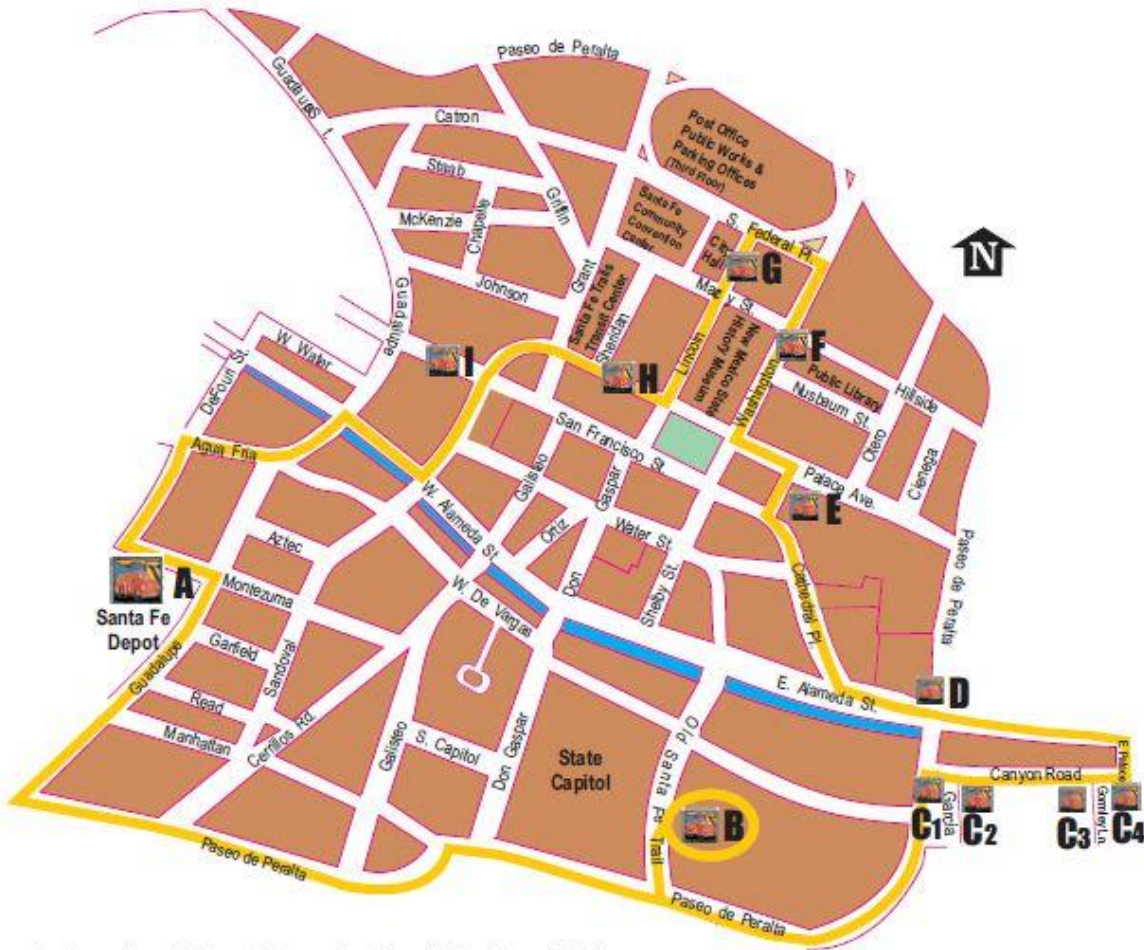
## 2014 APRIL

CALENDAR YEAR / MONTH

SUNDAY  
FIRST DAY OF WEEK

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	01	02 <b>Route 2 Express Bus Pilot 7-9am and 4-6pm</b>	03 <b>Route 2 Express Bus Pilot 7-9am and 4-6pm</b>	04 <b>Route 2 Express Bus Pilot 7-9am and 4-6pm</b>	05
06	07	08	09	10	11	12
13	14	15 <b>M Line and Pickup Observations</b>	16 <b>At the Bus Stop Interactions</b>	17 <b>M Line and Pickup Observations &amp; At the Bus Stop Interactions</b>	18	19
20	21	22 <b>Transit Advisory Board Presentation</b>	23	24	25	26
27	28	29	30	01	02	03

## 8.8 Appendix J: Santa Fe Pick-Up Route



- Arrive at and depart from the Santa Fe Depot (A)
- B Roundhouse/PERA
  - C1 610 Canyon Road
  - C2 Canyon Road at Garcia
  - C3 Canyon Road at Gormley
  - C4 Canyon Road at E. Palace
  - D Alameda & Paseo de Peralta
  - E St. Francis Cathedral
  - F Main Library
  - G City Hall/Convention Center
  - H Museums/Plaza
  - I Eldorado and Hilton Hotels

Map is representational and not to scale



## 8.9 Appendix K: Express bus schedule for Option 1

ROUTE 2 - DOWNTOWN - GUADALUPE - CERRILLOS - SANTA FE PLACE							ROUTE 2 - DOWNTOWN - GUADALUPE - CERRILLOS - SANTA FE PLACE						
WEEKDAY OUTBOUND							WEEKDAY INBOUND						
Downtown Transit Center <b>7</b>	Santa Fe Depot <b>6</b>	Saint Francis / Cordova <b>5</b>	South Capitol Station <b>4</b>	Cerrillos & Osage <b>3</b>	Cerrillos & Siler <b>2</b>	Santa Fe Place <b>1</b>	Santa Fe Place <b>1</b>	Cerrillos & Siler <b>2</b>	Cerrillos & Osage <b>3</b>	South Capitol Station <b>4</b>	Saint Francis / Cordova <b>5</b>	Santa Fe Depot <b>6</b>	Downtown Transit Center <b>7</b>
-	-	-	-	-	-	-	5:30a	5:41a	5:45a	-	6:01a	6:09a	6:13a
-	-	-	-	-	-	-	6:12a	6:21a	6:25a	-	6:29a	6:37a	6:41a
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-	-	-	-	-	-	-	<b>7:00a</b>	-	<b>7:03a</b>	-	<b>7:14a</b>	<b>7:28a</b>	<b>7:28a</b>
6:28a	6:32a	6:40a	-	6:47a	6:51a	7:03a	7:03a	7:15a	7:19a	-	7:21a	7:29a	7:33a
6:50a	6:54a	7:02a	-	7:07a	7:11a	7:23a	7:09a	7:21a	7:25a	-	7:29a	7:37a	7:41a
7:12a	7:16a	7:24a	-	7:29a	7:33a	7:45a	7:29a	7:41a	7:45a	-	7:49a	7:57a	8:01a
<b>7:30a</b>	-	<b>7:43a</b>	-	-	<b>7:55a</b>	<b>7:58a</b>	<b>8:00a</b>	8:02a	<b>8:06a</b>	-	8:10a	<b>8:18a</b>	<b>8:22a</b>
-	-	-	-	-	-	-	8:05a	8:17a	8:21a	-	8:25a	8:33a	8:37a
7:30a	7:34a	7:42a	-	7:48a	7:52a	8:04a	8:20a	8:32a	8:36a	-	8:40a	8:48a	8:52a
7:42a	7:46a	7:54a	-	7:59a	8:03a	8:15a	8:35a	8:47a	8:51a	-	8:55a	9:03a	9:07a
7:57a	8:01a	8:09a	-	8:14a	8:18a	8:30a	8:50a	9:02a	9:06a	-	9:10a	9:18a	9:22a
8:12a	8:16a	8:24a	-	8:29a	8:33a	8:45a	9:05a	9:17a	9:21a	-	9:25a	9:33a	9:37a
8:27a	8:31a	8:39a	-	8:44a	8:48a	9:00a	9:20a	9:32a	9:36a	-	9:40a	9:48a	9:52a
<b>8:30a</b>	-	<b>8:43a</b>	-	-	<b>8:55a</b>	<b>8:58a</b>	9:35a	9:47a	9:51a	-	9:55a	10:03a	10:07a
8:42a	8:46a	8:54a	-	9:01a	9:05a	9:17a	-	-	-	-	-	-	-
3:42p	3:46p	3:54p	-	3:59p	4:03p	4:15p	4:33p	4:45p	4:49p	-	4:53p	5:01p	5:05p
3:57p	4:01p	4:09p	-	4:14p	4:18p	4:30p	4:48p	5:00p	5:04p	-	5:10p	5:18p	5:22p
-	-	-	-	-	-	-	<b>5:00p</b>	-	<b>5:13p</b>	-	<b>5:24p</b>	<b>5:28p</b>	<b>5:28p</b>
4:12p	4:16p	4:24p	-	4:29p	4:33p	4:45p	5:03p	5:15p	5:19p	-	5:23p	5:31p	5:35p
4:27p	4:31p	4:39p	-	4:44p	4:48p	5:00p	5:18p	5:30p	5:34p	-	5:38p	5:46p	5:50p
<b>4:30p</b>	-	<b>4:33p</b>	-	-	<b>4:45p</b>	<b>4:58p</b>	-	-	-	-	-	-	-
4:42p	4:46p	4:54p	-	4:59p	5:03p	5:15p	5:33p	5:45p	5:49p	-	5:58p	6:06p	6:10p
4:57p	5:01p	5:09p	-	5:14p	5:18p	5:30p	<b>6:00p</b>	-	<b>6:13p</b>	-	<b>6:24p</b>	<b>6:28p</b>	<b>6:28p</b>
5:12p	5:16p	5:24p	-	5:29p	5:33p	5:45p	6:03p	6:15p	6:19p	-	6:25p	6:33p	6:37p
5:27p	5:31p	5:39p	-	5:44p	5:48p	6:00p	-	-	-	-	-	-	-
<b>5:30p</b>	-	<b>5:33p</b>	-	-	<b>5:45p</b>	<b>5:58p</b>	-	-	-	-	-	-	-
5:57p	6:01p	6:09p	-	6:16p	6:20p	6:32p	6:35p	6:47p	6:51p	-	6:55p	7:03p	7:07p